

# Leaked & Combusted



**Strategies for reducing the  
hidden costs of methane  
emissions & transitioning off gas**

By Dorie Seavey, PhD  
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## About the Author

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## About HEET

HEET is an innovative climate nonprofit working to accelerate an efficient and equitable thermal energy transition through systems change. We believe in an affordable, equitable transition to clean energy that meets the needs of all, from low-income communities to gas utility workers to future generations. To accomplish this, we build collaborative networks based on trust, identify solutions supported by science, and bring uncommon partners together to find common ground. This allows us to meet the speed and scale this moment in history demands.

HEET is a 501(c)(3) nonprofit that does not take funding from the utility, fossil fuel, or geothermal industries.

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## Acronyms

Acronym	Definition
ACEEE	American Council for an Energy-Efficient Economy
ALDP	advanced leak detection program
AGA	American Gas Association
ASHP	air source heat pump
BDC	Building Decarbonization Coalition
Btu	British thermal units
BERDO	Building Emissions Reduction and Disclosure Ordinance
BEUDO	Building Energy Use Disclosure Ordinance
capex	capital expenditures
CO PUC	Colorado Public Utilities Commission
CT PURA	Connecticut Public Utilities Regulatory Authority
CISBOT	cast-iron sealing robots
CPUC	California Public Utilities Commission
CRDS	cavity ring-down spectroscopy
DOE	U.S. Department of Energy
DOEE	Department of Energy & Environment, Washington DC
DOER	Department of Energy Resources
DOT	U.S. Department of Transportation
DPU	Massachusetts Department of Public Utilities
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
EJ	environmental justice
EV	electric vehicles
GHG	greenhouse gas
GHGI	Greenhouse Gas Inventory
GSEP	Gas System Enhancement Plans
HEERA	High Efficiency Electric Home Rebate Act
HOMES	Home Owner Managing Energy Savings
HVAC	heating ventilation and air conditioning
ICC	Illinois Commerce Commission

IEA	International Energy Agency
IJA	Infrastructure Investment and Jobs Act
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act of 2022
ISO-NE	Independent System Operator-New England, Inc.
LAUF	lost and unaccounted for (gas)
LDAR	leak detection and repair
LDC	local distribution company
LEA	line extension allowances
LNG	liquefied natural gas
MassDEP	Massachusetts Department of Environmental Protection
MCF	one thousand cubic feet
NARUC	National Association of Regulatory Utility Commissioners
NGDISM	Natural Gas Distribution Infrastructure Safety and Modernization
NPA	non-gas pipeline alternative
NPRM	notice of proposed rulemaking
NY PSC	New York Public Service Commission
NRDC	Natural Resources Defense Council
PNAS	Proceedings of the National Academy of Sciences
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM	particulate matter
PUC	Public Utility Commission
RECS	Residential Energy Consumption Survey
RNG	renewable natural gas
SEI	significant environmental impact
scfh	standard cubic feet per hour

## Executive Summary

Delivered by vast pipeline networks that crisscross the country, natural gas has become America's dominant energy source, accounting for just over 70 percent of the energy used to heat residences and 40 percent of the energy powering electricity generation. Extracted from geologic formations formed millions of years ago, this fossil gas consists largely of methane, an energy-dense fuel that we now know comes at great costs to society when it escapes from the pipelines that carry it and when it is combusted in equipment and appliances. The resulting emissions are substantial and make a major contribution to climate warming and harmful indoor and outdoor air pollution.

Focusing on the downstream portion of the gas supply chain—the part servicing residential and commercial consumers—this report presents a comprehensive analysis of the challenges and opportunities for reducing gas-related emissions. It surveys the complex landscape of emissions measurement and the harm that methane emissions exact on human, environmental, and climate health. It addresses the growing disruption to the economics of gas caused by the emerging transition to a low-carbon economy and the gas industry's main responses: aggressive pipeline replacement, new load growth, and the pursuit of alternative combustible gases. Finally, the report considers what citizens, community groups, scientists and researchers, town officials, state policymakers, and utility regulators can do to deeply reduce and eliminate methane emissions and redirect gas-based energy systems to a new energy future based on reduced energy demand, decarbonized electricity, and electrification.

### **This landscape analysis finds that:**

#### **To fight climate change, the U.S. needs accurate methane accounting.**

Methane is a key driver of climate change and, therefore, a critical lever for slowing global warming. At the same time, methane emissions are substantially underestimated, hampering our ability to tackle the climate crisis at the speed needed to avert the worst consequences.

#### **The true costs of fossil gas are hidden.**

The downstream gas industry does not bear the immense social costs of the gas it delivers—costs that account for the long-term harm fossil gas causes to our health, the environment, and the climate. When these costs are taken into account, gas is actually far more expensive than electricity.

#### **The expensive gas pipeline replacement programs underway in many states are on course to become a trillion dollar boondoggle for the U.S.**

Continuing current spending levels will create unsustainable rate increases for millions of Americans and commit the country to an intensive, protracted gas infrastructure replacement cycle at a time when heat pumps are already more popular than gas furnaces across the country and gas demand is expected to fall.

### Continuing massive investments in the current gas distribution system is economically irrational.

The gas distribution industry's long-term financial prospects are increasingly tenuous as the underlying economics of gas head toward deep disruption. In particular, a growing amount of the market value of gas utilities is tied to assets whose costs may not be recoverable. However, current regulatory structures and utility business models continue to encourage gas utilities to vastly overinvest in pipeline replacement and underinvest in leak detection and repair.

### Regulators are critical gatekeepers of the energy transition underway.

State regulatory practices for gas distribution utilities are outdated and misaligned with state climate policy and greenhouse gas reduction goals. Regulatory reform must prioritize long-term gas planning that intelligently downsizes the gas system through a managed, phased approach, carefully coordinated with electric utilities to minimize grid expansion requirements and costs.

### The energy transition for lower-income and environmental justice communities should be prioritized.

These populations are at substantial risk of being left behind on an aging, underutilized gas network facing unaffordable increases in gas rates. Ensuring that this critical part of the residential sector has access to clean heating technologies and full building retrofit resources will dramatically reduce energy use and greenhouse gas emissions for the entire building sector while bringing strong economic, health, and social benefits to communities that have historically shouldered a disproportionate share of the negative impacts of fossil fuels.

With climate catastrophe now a clear and present danger, this analysis demonstrates that a strategic, two-pronged approach is essential—one that immediately abates methane emissions and substantially curtails new investment in gas infrastructure and at the same time drives a managed, phased transition away from gas.

Near-term priority actions do not require extensive investigation or fact-finding. Their primary goal is to speed up the abatement of climate-damaging methane emissions, but they also realize important benefits for health, public safety and the environment and build critical awareness of the need for structural energy systems change. Coordinated civic, governmental, regulatory, and industry action is needed to:

- » Adopt accurate emission measurement methodologies based on the best science available and that factor in the social costs of methane emissions
- » Curtail further investments in existing gas distribution infrastructure by, for example, sunseting accelerated cost recovery programs for pipeline replacement, restricting capital spending to the highest risk pipes, and requiring screening for non-gas pipeline alternatives
- » Shift the emphasis from pipeline replacement to advanced leak detection and repair with selective vintage pipeline replacement

- » Require new buildings and building upgrades to use the latest clean technologies
- » Adopt robust state methane reduction programs for gas utilities with emission taxes and fees that reflect the social costs of methane

Longer-term gas planning processes and rulemaking must run parallel to near-term action. States and cities need to start now to provide for a managed, phased transition off of gas. The alternative is a disorderly transition that relies on a scattershot approach to electrification. An unmanaged transition will continue to lock in sizable ongoing gas infrastructure and operational costs even as gas assets become underutilized, and will result in greater stranded assets and legal claims.

Cutting methane emissions at the level and rate required will involve simultaneous, ambitious efforts to electrify energy end use, reduce energy demand through efficiency measures, and decarbonize the electrical grid. To play its part in this transformative change, gas utility planning and utility regulation must:

- » Halt expansion of the gas system, preventing line extensions, new customer hook-ups, and customer conversions
- » Reform utility energy efficiency programs so that they support building electrification and decarbonization for everyone rather than simply emphasizing costs savings from energy efficiency and allowing benefits and subsidies to disproportionately accrue to higher-income households
- » Develop comprehensive long-term plans for downsizing the gas system according to managed phases that rely on a neighborhood street-segment approach



# I. Introduction

*“In a world on fire, stop burning things.”*

— Bill McKibben, author, educator, environmentalist,  
founder of Third Act and co-founder of 350.org.  
Published in *The New Yorker*, March 18, 2022.

Over the last six decades, America’s consumption of fossil gas (also known as “natural” or methane gas)<sup>1</sup> has nearly tripled. Gas has become America’s dominant energy source, accounting for 72 percent of the energy used to heat residences<sup>2</sup> and 40 percent of the energy powering electricity generation.<sup>3</sup> Continuing this energy direction is unsustainable for climate, health, and economic reasons.

Whether leaked or combusted, gas is a major contributor to climate warming. It is extracted “upstream,” mostly from fracking fields, then moved through “midstream” processing and storage facilities, then to transmission pipelines which connect to more than a million miles of “downstream” distribution pipeline (see Figure 1). Unburned gas escapes into the atmosphere along the entire production and supply chain, endangering human health and safety as well as climate stability and the environment. Some of these emissions are unintentional but inevitable, for example, when gas pipes corrode or crack underground or when leaks occur at metering and pressure stations; others are due to intentional purging and venting for maintenance and repairs. Still others occur due to third-party excavation damages. When leaked into confined spaces, gas is highly flammable and potentially explosive. When leaked into buildings through faulty connections, normal operation of appliances, and even when equipment is turned off, fossil gas releases harmful chemicals and other gases that contribute to smog formation.

Methane emissions are detrimental to the climate because methane is a potent greenhouse gas and major contributor to global warming. While its effects on the climate are not nearly as lasting as carbon dioxide, during its first twenty years in the atmosphere methane traps more than 80 times more heat than carbon dioxide.<sup>4</sup> Methane emissions from all sources, including natural causes, are “responsible for around 30% of the rise in global temperatures since the industrial revolution,” and 60 percent of that contribution stems from anthropogenic causes such as agriculture and fossil fuel use.<sup>5</sup>

In sum, methane leaks create massive climate impacts and social and environmental costs that are borne by society, not the industry that extracts and sells the gas.

1 Natural gas is largely composed of methane (CH<sub>4</sub>)—up to 95% depending on its processing stage. This report will use the term fossil gas to refer to “natural gas.” For naming considerations, see Rebecca Leber, “[The end of natural gas has to start with its name.](#)” Vox (February 10, 2022); and Karine Lacroix et al., “[Should it be called ‘natural gas’ or ‘methane?’](#)” Yale Program on Climate Change Communication, Climate Note (December 1, 2020).

2 EIA, Office of Energy Demand and Integrated Statistics, [2020 Residential Energy Consumption Survey](#), Table CE4.1. See Figure 3 of this report.

3 EIA, “[What is U.S. electricity generation by energy source?](#)”

4 P. Forster et al., “[The Earth’s Energy Budget, Climate Feedbacks, and Climate Sensitivity.](#)” in Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the IPCC (2021).

5 IEA, Global Methane Tracker 2022, “[Methane and climate change.](#)”

In addition, methane has an outsized impact when combusted in appliances, equipment, and heating systems as well as by electricity-generating power plants. Burning methane releases carbon dioxide and other harmful air pollutants such as nitrogen oxides, carbon monoxide, fine particulate matter, and benzene, further damaging not only the climate and environment, but also human health.

Beyond these substantial climate and health reasons, the status quo is also unsustainable because market forces are disrupting the economics of the gas industry even as gas utilities make significant investments in their infrastructure and pursue alternative gases such as renewable natural gas and hydrogen. This doubling down on gas comes at a time when clean, energy-efficient space and water heating technologies have taken root and are becoming more cost effective.<sup>6</sup> The vast majority of new electricity generation capacity additions are now due to renewables, and new solar and energy storage projects account for 82 percent of all planned capacity additions in 2023.<sup>7</sup> In addition, leading policymakers and regulators are starting to address the massive externalities and social costs that are not priced into the commodity cost of fossil gas. The lack of proper price regulation constitutes a de facto subsidy to the profits of the fossil fuel industry that distorts business-as-usual decision making, for example, regarding whether to replace a mile of gas pipeline or build a “peaker plant.” Finally, concern is growing about the prospects of rapidly increasing costs for customers remaining on the gas system and the prospect of large undepreciated balances for the gas system which could become stranded.

While all modes of transmission and use of methane contribute to its negative impacts, this report focuses on methane in the gas distribution system, both leaked and burned. Controlling emissions from the upstream and midstream gas system often captures more attention, as these emissions seem more substantial. However, the downstream gas distribution system is also critically important because it is the locus of consumer demand—that is, the decision making that directs gas to hundreds of millions of furnaces, boilers, hot water heaters, dryers, ovens, and stoves. The energy transition is reshaping that demand, pushed by better scientific understanding of methane’s harms and growing awareness that reducing methane emissions, because of its outsized heat-trapping capacity, is the single greatest lever for slowing down the warming of the planet and averting climate catastrophe.

In presenting a comprehensive analysis of the challenge of reducing and eliminating methane emissions, this report focuses attention on the imperative of reducing methane emissions as quickly as possible while also building a sustainable energy future that does not depend on combusting gas. This will ultimately require moving away from using gas and decommissioning the gas system over the course of several decades. This report begins by reviewing the urgency of reducing downstream methane emissions and the serious problems of relying on gas in our homes and businesses. From that foundation, it explores the changing economics of gas and the response of the gas industry, both in terms of its capital investment and its stance with public regulators and state legislatures. Finally, it evaluates what communities, municipalities, and states can do about the

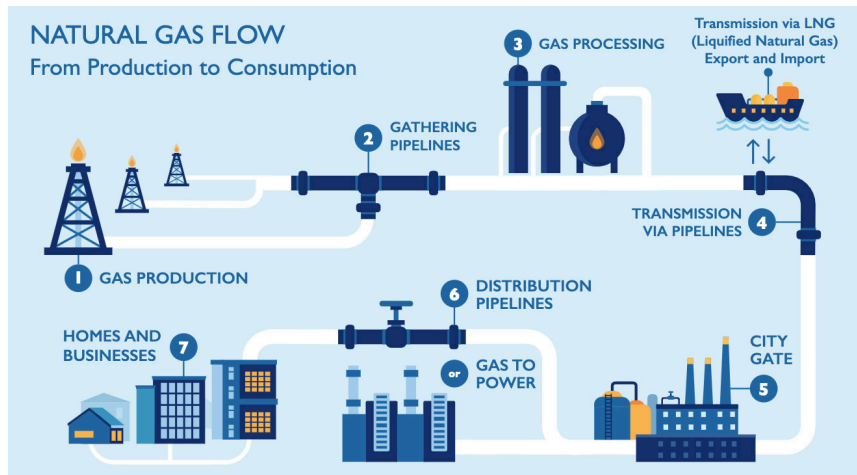
6 Maria Virginia Olano, “[10 charts that sum up 2023’s clean energy progress](#),” Canary Media (December 27, 2023).

7 EIA, “[More than half of new U.S. electric-generating capacity in 2023 will be solar](#)” (February 6, 2023).

problem of downstream methane emissions and the impacts of efforts already underway. Recommended policies and actions cover simultaneous initiatives to curb methane emissions in the near-term and to strategically, permanently eliminate the use of gas.

### Figure 1: America’s fossil gas supply chain

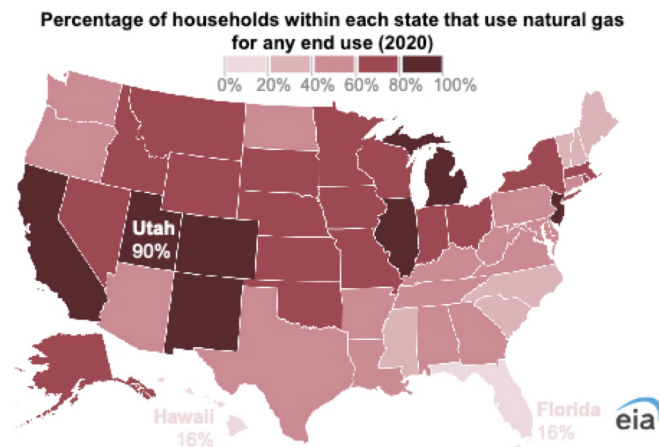
Methane gas is piped from “upstream” wellheads and processing plants through 412,000 miles of gathering and transmission pipes (“midstream”) and then to consumers “downstream” through 1.4 million miles of distribution pipeline networks owned mostly by private companies and sometimes by municipalities.<sup>8</sup>



Source: [NARUC](#)

### Figure 2: Percentage of households by state that use fossil gas for any end use (2020)

In 2020, 61 percent of U.S. households used fossil gas for at least one energy end use, according to the 2020 [Residential Energy Consumption Survey](#). In seven states (CA, CO, IL, MI, NJ, NM, UT), 80 percent or more of households rely on fossil gas. Space heating, water heating, and cooking were the most common end uses; roughly half of U.S. households used fossil gas for space heating, closely followed by water heating.

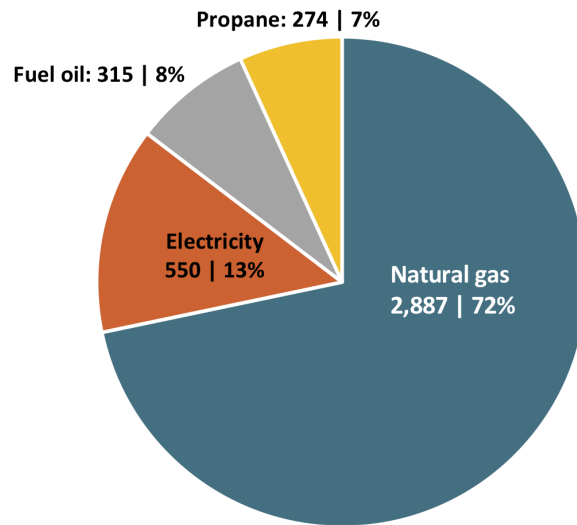


Source: [U.S. Energy Information Administration](#)

8 AGA, [Gas Facts: Distribution and Transmission Miles of Pipeline](#) (2022).

**Figure 3: Residential space heating energy use by fuel (trillion Btu), 2020**

In 2020, 72 percent of the energy used by U.S. households for residential space heating came from natural gas.



Source: EIA, [2020 Residential Energy Consumption Survey](#), Table CE4.1.

## II. Urgency of Reducing Methane Emissions from Downstream Gas Systems

Avoiding catastrophic climate impacts requires dramatically reducing methane emissions while also addressing carbon dioxide emissions.<sup>9</sup> Fortunately, our scientific understanding of methane has advanced over the last decade, as has independent research that quantifies emissions associated with downstream distribution and use of fossil gas. Knowing how much methane is leaking and more about the impacts and costs of downstream gas emissions is an important foundation of an effective, equitable strategy to shift away from reliance on gas.

### A. How much methane is leaking downstream?

Considerable uncertainty surrounds the size of the national methane inventory and the role that downstream emissions play in that accounting. The public's understanding of methane has followed the gas industry's presentation that gas is "clean," "natural," domestically produced, and economical.<sup>10</sup> The industry asserts that "Natural gas distribution systems have a small emissions footprint shaped by a declining trend."<sup>11</sup> When leaks are taken into account, however, a very different profile of gas is revealed with strong evidence that downstream methane emissions are significantly underestimated.

The U.S. Department of Transportation recently affirmed this conclusion in a report presenting the rationale for strengthened federal leak detection and repair regulations. The Pipeline and Hazardous Materials Safety Administration (PHMSA), the division authoring the report, found that "Recent research using modern leak detection equipment indicates that overall fugitive methane emissions from gas pipeline facilities [including gas distribution pipelines] may be significantly underestimated in current methane emissions estimates."<sup>12</sup>

Atmospheric methane concentrations in and around many cities—measured via what are known as "top-down" methods such as airplane flyovers, satellites, and towers—are more than double estimates derived by "bottom-up" estimates which are built from engineering calculations that essentially multiply counts of throughput or miles of pipes by emission and activity factors (estimates of gas-loss rates per unit of activity).<sup>13</sup> For example:

- » A national study of downstream emissions by Weller et al. estimated annual emissions from gas mains that are five times larger than the U.S. Greenhouse Gas Inventory estimate for 2017 (0.69 million metric tons of methane vs. 0.14 million metric tons).<sup>14</sup>

<sup>9</sup> IEA, [The Imperative of Cutting Methane from Fossil Fuels](#) (October 2023).

<sup>10</sup> AGA, [Understanding Greenhouse Gas Emissions from Natural Gas](#) (October 2022), p. 1.

<sup>11</sup> Ibid.

<sup>12</sup> DOT, PHMSA, [Notice of Proposed Rulemaking, Pipeline Safety: Gas Pipeline Leak Detection and Repair](#) (May 4, 2023), pp. 7, 42.

<sup>13</sup> The vast majority of bottom-up inventories use emission factors derived from industry averages rather than measurements specific to the company.

<sup>14</sup> Zachary D. Weller et al., "A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems," [Environmental Science & Technology](#) (2020).

- » A longitudinal study of the Boston metropolitan area—an East Coast city with older, leak-prone gas infrastructure—found no evidence that methane emissions have declined despite significant investment by gas utilities in pipeline replacement and the initiation of new regulations targeting the largest leaks.<sup>15</sup>
- » Researchers have also found that emissions from residential gas heating and cooking equipment such as furnaces and stoves may be a significant source of methane emissions, particularly in urban areas, and could contribute significantly to national-scale emissions.<sup>16</sup> Leaks from distribution pipelines have been assumed to be the main source of fugitive emissions, but researchers observe diffuse methane plumes above cities, including Boston, Los Angeles, and Washington, DC, that appear correlated with seasonal end use (for example, furnaces used more in the winter season).

Together, these findings have two important implications for understanding the impacts of gas as a fuel and identifying the most effective policies to reduce methane emissions. First, the climate footprint of downstream gas has been significantly underestimated and makes up a far greater proportion of the entire fossil gas supply chain. Second, policy focused on fixing gas leaks in the streets ignores post-meter emissions and therefore its impact is limited. If substantial methane emissions result from end uses, then efforts to reduce gas consumption will not only help eliminate methane emissions, but also reduce the harmful impacts of burning gas in homes.<sup>17</sup>

Researchers and community-based climate groups have been taking advantage of technological advancements to conduct gas leak mapping and measurement projects in nearly two dozen cities. Some studies have been led by academic researchers and reported in peer-reviewed publications or supported by the Environmental Defense Fund and Sierra Club. Others were organized by HEET, a nonprofit climate solutions incubator based in Massachusetts. Most have used vehicle-based mobile methane surveys.<sup>18</sup>

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15 Measurement was conducted over the period 2012 to 2020. Maryann R. Sargent et al., "[Majority of U.S. urban natural gas emissions unaccounted for in inventories](#)," PNAS (2021).

16 Maryann R. Sargent et al., "[Majority of U.S. urban natural gas emissions unaccounted for in inventories](#)," PNAS (2021), p. 4; Patricia M. B. Saint-Vincent and Natalie J. Pekney, "[Beyond-the-Meter: Unaccounted Sources of Methane Emissions in the Natural Gas Distribution Sector](#)," Environmental Science & Technology (2020); and Marc L. Fischer et al., "[An Estimate of Natural Gas Methane Emissions from California Homes](#)," Environmental Science & Technology (2018). Beginning with its 2023 report on the U.S. GHGI, the EPA recognized "post-meter" CH<sub>4</sub> emissions as an additional source of methane emissions, following the recommendations of the IPCC. See EPA, "[Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021](#)" (2023), Chapter 3, pp. 3-95 to 3-97. In 2022, the EPA provided a [memo](#) on its treatment of post-meter emissions. The EPA derived an emissions factor for post-meter CH<sub>4</sub> emissions based on selected research articles and then applied that factor to a count of gas-using residences in the U.S.

17 This shift in policy focus receives support from the U.S. GHGI for the period 1990 to 2021. It reports that 45% of the CH<sub>4</sub> emissions from the distribution system are post-meter (13 MMT CO<sub>2</sub> equivalent out of 28.3 MMT total). See Table 3-66, "[Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021](#)" (2023), Chapter 3.

18 Zachary D. Weller et al., "[Vehicle-Based Methane Surveys for Finding Natural Gas Leaks and Estimating Their Size: Validation and Uncertainty](#)," Environmental Science & Technology (2018).

<b>Table 1: Mapping and measuring gas leaks in urban areas</b>			
<b>State/locality (year)</b>	<b>Sponsor/researchers</b>	<b>Type of survey</b>	<b>Findings</b>
<b>7 urban areas (2021):</b> New York, Philadelphia, Washington, DC, Baltimore, Boston, Chicago, Richmond, and Indianapolis	<a href="#">Cody Floerchinger et. al</a>	Airborne measurements of CH <sub>4</sub> and ethane	U.S. emission inventories significantly underestimate the role of gas relative to biogenic CH <sub>4</sub> in urban environments
<b>Washington, DC (2021)</b>	<a href="#">HEET</a> , Gas Safety USA, and Boston University collaboration	High-precision vehicle-mounted methane analyzer	Surveyed 713 miles of road, identifying 3,346 leaks attributable to gas pipes (5 leaks per mile)
<b>Philadelphia (2021-2022)</b>	<a href="#">HEET</a> and Gas Safety USA	High-precision vehicle-mounted methane analyzer	Surveyed 383 miles of road, identifying 1,533 leaks (4 leaks per mile)
<b>14 major cities:</b> Boston, Indianapolis, Birmingham, Burlington, Chicago, Dallas, Elizabeth, Jacksonville, Long Island, Los Angeles, Mesa, Pittsburgh, Staten Island, and Syracuse	<a href="#">EDF Methane Maps Project</a>	Google Street View cars with methane sensors	See write-up for individual city results
<b>Washington, DC (2021- 2022)</b>	<a href="#">Sierra Club</a> with Beyond Gas DC	Industry-grade methane detector inserted into street-level access caps	Nearly 400 active leaks in Washington Gas territory (covering all 8 city wards) found by neighborhood researchers
<b>Philadelphia (2021)</b>	<a href="#">Sierra Club SE Pennsylvania</a> with Gas Safety USA	High-precision vehicle-mounted methane analyzer	Approximately 1,000 leaks identified (study surveyed a portion of the city)
<b>Philadelphia (2021)</b>	<a href="#">Daniel Anderson et al.</a>	Roadside monitors	Found CH <sub>4</sub> /CO <sub>2</sub> emission ratios that were almost 4 times emission inventories reported by the EPA
<b>Hartford, Danbury, and New London, CT (2019)</b>	<a href="#">Tim Keyes et al.</a>	Mobile cavity ring-down spectrometer	Found much higher leak rates than reported by CT Public Utilities Regulatory Authority (e.g., Hartford @ 4.3 leaks per mile or 313 metric tons/year)
<b>6 large cities in the East Coast Region (2019)</b>	<a href="#">Plant et al.</a>	Aircraft observations	Found emissions levels more than double estimates from U.S. EPA inventory

<b>Washington, DC (2014)</b>	<a href="#">Robert Jackson et al.</a>	Mobile cavity ring-down spectrometer	Mapped leaks over 1,500 miles finding 5,893 leaks. At 19 high-leakage sites, CH <sub>4</sub> concentrations were 10x greater than the threshold at which explosions can occur
<b>Boston (2013)</b>	<a href="#">Nathan Phillips et al.</a>	Mobile cavity ring-down spectrometer	Mapped leaks across all 785 road miles of Boston, identifying 3,356 leaks (4.3 leaks per mile) with concentrations exceeding up to 15 times the global background level

The studies presented in Table 1 find methane leaks from gas distribution systems on the order of 1.5 to 4 times greater than those reported by utilities and state utility regulatory authorities,<sup>19</sup> demonstrating that official measurement methodologies severely understate methane leakage. Weller and Lamb conclude that “[gas distribution systems] have many more leaks than [gas utilities] are able to find using their existing leak survey equipment and methods.”<sup>20</sup> To improve leak detection, they recommend using more sensitive instruments coupled with additional training.

In addition to independent efforts to map leaks, HEET has geocoded gas leaks data from annual gas utility reports, using these datasets to generate publicly available, interactive maps.<sup>21</sup> The maps can be used to show overall gas leak density or to zoom in on one’s home, school, or business to view reported nearby gas leaks.

In Massachusetts, town governments in [Arlington](#), [Salem](#), and [Wellesley](#) are using HEET’s geocoded data to develop customized gas leaks portals or platforms to provide information on known leaks, progress making repairs, and the climate and health dangers of fugitive methane. In Newton, a group of volunteers has developed a tool, also using mapping services from HEET, to conduct geospatial analysis relating to gas leaks and environmental justice (EJ). They have also written a report analyzing the effectiveness of their gas utility’s pipeline replacement projects and cost recovery practices<sup>22</sup> and are part of a grassroots municipal campaign for a future without gas.<sup>23</sup> Filings using HEET’s resource tool have been made to regulatory authorities in charge of reviewing and approving gas replacement plans to show the disproportionate concentration of leaks in EJ communities.<sup>24</sup>

19 Plant et al. report observed methane emissions from cities that are roughly twice that reported in the EPA GHGI (Plant et al., “[Large fugitive methane emissions from urban centers along the U.S. East Coast](#),” Geophysical Research Letters (July 2019). Weller et al. estimate nationwide methane emissions from gas distribution lines that are about five times greater than projected by the EPA GHGI (Weller et al., “[A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems](#),” Environmental Science & Technology (June 2020).

20 Zachary D. Weller et al., “[Vehicle-Based Methane Surveys for Finding Natural Gas Leaks and Estimating Their Size: Validation and Uncertainty](#),” Environmental Science & Technology (2018).

21 HEET [gas leak maps](#).

22 See the work of the [Newton Gas Pipes Team](#).

23 See Newton’s [Campaign for a Future without Gas and for Clean Heat](#).

24 Marcos Luna and Dominic Nicholas, “[An environmental justice analysis of distribution-level natural gas leaks in Massachusetts, USA](#),” Energy Policy (2022).



## B. Why are methane emissions hazardous, harmful, and costly?

While leaking gas pipelines have long been recognized as a safety risk, fugitive methane's climate impact is also considerable. Research is also establishing the significant health impacts of both burning and leaking gas, both outdoors and indoors. These safety, climate, and health impacts all carry significant costs.

### Public safety impacts

Methane leaks can be extremely dangerous. Even a small leak or a rupture in a gas line can lead to an explosion, killing or harming people and destroying or damaging property. Gas appliances can also leak gas and present an explosion risk.

Most reported incidents are caused by excavation mishaps that rupture a gas line. But pipelines can corrode and fail due to their material, age, and condition. The risk of pipeline failure is tied to several factors including the material, age, and condition of the pipelines, and the frequency and quality of maintenance and inspections. In the United States, from 2010 to 2020, there were 256 significant distribution pipeline incidents attributable to corrosion or equipment, material, or maintenance failures. "From these incidents, there were 13 fatalities, 161 injuries requiring inpatient hospitalization, and an estimated total cost (including property damage, emergency response, and gas released) of \$1.7 billion."<sup>25</sup>

### Climate impacts

While carbon dioxide has the greatest impact on long-term climate change, methane emissions from the gas system are a major driver of short-term global warming and climate disruption. Methane has a short atmospheric life compared to carbon dioxide but makes an outsized contribution to global warming, trapping heat at 84 to 87 times the rate of carbon dioxide over a twenty-year period.<sup>26</sup> Methane is also an important precursor to ground-level ozone, a dangerous air pollutant that has detrimental effects on ecological systems and agriculture, including lowering crop yields and quality.<sup>27</sup>

Some researchers conclude that, once methane leakage is taken into account, gas may be as harmful to the climate as coal:<sup>28</sup> "Many coal-to-gas comparisons consider only end-use combustion, factoring in emissions from a power plant or home furnace. This leaves out total greenhouse gas (GHG) life-cycle emissions created by extracting, shipping, and processing natural gas and coal. In reality, methane leakages drive emissions parity between gas and coal, especially through the gas supply chain."<sup>29</sup>

### Human health impacts

Unburned fossil gas is harmful to human health. While gas is about 95 percent methane (CH<sub>4</sub>), it also contains toxic and carcinogenic pollutants, including benzene, toluene,

25 Zachary D. Weller et al., "[Environmental injustices of leaks from urban natural gas distribution systems: Patterns among and within 13 U.S. metro areas](#)," *Environmental Science & Technology* (2022), p. 8606.

26 IEA, [Methane Tracker 2021](#) (Paris, 2021).

27 UN Environment Programme and Climate and Clean Air Coalition, [Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions](#) (2021).

28 Deborah Gordon et al., "[Evaluating net life-cycle greenhouse gas emissions intensities from gas and coal at varying methane leakage rates](#)," *Environmental Research Letters* (July 2023); and Hiroko Tabuchi, "[Leaks Can Make Natural Gas as Bad for the Climate as Coal, A Study Says](#)," *The New York Times* (July 13, 2023).

29 Deborah Gordon and Shannon Hughes, "[Reality Check: Natural Gas's True Climate Risk](#)," RMI (July 13, 2023).

heptane, and cyclohexane, that are known to cause a wide range of adverse health impacts. These pollutants are emitted across the gas life cycle, from extraction to processing and transport, to local distribution systems, and into homes and businesses.<sup>30</sup> Methane itself is also an indirect health hazard, as mentioned above, because it is one of several precursors to ozone (smog), which is associated with respiratory diseases, independent of other air pollutants. Long-term exposure to ozone is responsible for up to 1 million deaths globally every year.<sup>31</sup> Furthermore, methane leaks are unequally distributed, often concentrated in low-income communities and communities of color, creating environmental and public health burdens that disproportionately affect more vulnerable populations.<sup>32</sup>

Recent research has also established the presence of harmful air pollution inside homes from both combustion and leaks. Samples of gas delivered to homes reveal 21 air pollutants known to cause cancer and other health problems.<sup>33</sup> Studies find that gas stoves leak significant amounts of methane even when they are turned off.<sup>34</sup> When gas is combusted, in addition to producing carbon dioxide, a number of harmful compounds are released, including benzene, NO<sub>x</sub>, fine inhalable particles (PM<sub>2.5</sub>), and formaldehyde.<sup>35</sup>

These combustion-related compounds constitute a major source of air pollution within homes, and gas stoves are now known to be a health risk. A study measuring indoor emissions from gas and propane stoves inside 87 homes in California and Colorado found that burning these fuels spiked indoor concentrations of benzene. The cancer-causing chemical migrated throughout homes, in some cases elevating concentrations above safe levels for hours after the stove was turned off.<sup>36</sup> A recent public health burden study found that 12.7 percent of current childhood asthma nationwide is attributable to gas stove use, similar to secondhand smoke exposure.<sup>37</sup>

In response to a recommendation by the Intergovernmental Panel on Climate Change (IPCC), the U.S. Environmental Protection Agency (EPA) has now adjusted its inventory of greenhouse gases released in the United States to include methane emissions from residential and commercial appliances as well as other sources.<sup>38</sup> For 2021, the EPA

30 Elena Shao, "[Gas Piped Into Homes Contains Benzene and Other Risky Chemicals, Study Finds](#)," *The New York Times* (June 28, 2022).

31 Christopher S. Malley et al., "[Updated Global Estimates of Respiratory Mortality in Adults > 30 Years of Age Attributable to Long-Term Ozone Exposure](#)," *Environmental Health Perspectives* (2017). See also "[Methane](#)," Climate & Clean Air Coalition.

32 Marcos Luna and Dominic Nicholas, "[An environmental justice analysis of distribution-level natural gas leaks in Massachusetts, U.S.A.](#)," *Energy Policy* (2022); and Zachary D. Weller et al., "[Environmental injustices of leaks from urban natural gas distribution systems: Patterns among and within 13 U.S. metro areas](#)," *Environmental Science & Technology* (2022).

33 A recent study of gas customers in Greater Boston, MA, sampled the gas entering kitchen stoves and buildings and found 21 different chemicals designated by the EPA as hazardous air pollutants that can cause cancer and other serious health effects. Drew R. Michanowicz et al., "[Home is where the pipeline ends: Characterization of volatile organic compounds present in natural gas at the point of the residential end user](#)," *Environmental Science & Technology* (2022). See also Sabrina Shankman, "[Scientists tested the natural gas used in kitchen stoves around Boston. They found dangerous chemicals](#)," *The Boston Globe* (June 28, 2022).

34 Eric D. Lebel et al., "[Methane and NO<sub>x</sub> Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes](#)," *Environmental Science & Technology* (January 2022). A notable finding of this study is that more than three-quarters of measured methane emissions originated during steady-state-off. For an overview report on gas stove pollution, see Brady Anne Seals and Andee Krasner, [Health Effects from Gas Stove Pollution](#), RMI, Physicians for Social Responsibility, Mothers Out Front, and Sierra Club (2020).

35 Yifang Zhu et al., "[Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California](#)" (2020).

36 Yannai S. Kashtan et al., "[Gas and propane combustion from stoves emits benzene and increases indoor air pollution](#)," *Environmental Science & Technology* (2023).

37 Taylor Gruenwald et al., "[Population attributable fraction of gas stoves and childhood asthma in the United States](#)," *International Journal of Environmental Research & Public Health* (2023).

38 EPA, [Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2020: Updates Under Consideration for Post-Meter Emissions](#) (September 2021).

estimates that post-meter emissions account for nearly half (46 percent) of total methane emissions from the downstream gas distribution system.<sup>39</sup>

### Vegetation impacts

Fugitive methane from gas distribution systems also kills trees and shrubs. When gas leaks from underground pipes, it migrates into the soil, displacing oxygen, drying the earth, and often suffocating the roots of the trees and plants. Studies now show that tree deaths from methane leaks are causing urban tree canopy decline, undermining the many public health benefits of trees such as improved air quality and shading and cooling.<sup>40</sup> In addition to the cost of replacing trees damaged by methane in the soil, these gas leaks also lead to loss of the carbon storage that vegetation provides and to higher health costs associated with the loss of tree canopy, particularly in urban areas.

## C. What are the health and climate costs of methane emissions?

The costs of downstream fugitive gas have two main components: the “private,” or production cost of the lost commodity itself and the “social,” or external societal costs caused by damages attributable to leaked methane. The latter are real costs since the degradation of the environment and climate are not free to the economy.

The private cost is the wholesale market cost of fossil gas (also known as the “commodity cost”). Gas ratepayers must cover the cost of “lost and unaccounted for” gas (LAUF) that is never delivered to them because utilities and regulators treat these emissions as a normal cost of doing business.

The commodity value of fugitive gas pales in comparison to its full social cost, for which no entity is responsible since environmental and “climate” quality is considered a public good. The social cost of a greenhouse gas (GHG) refers to the “monetary value of the net harm to society of emitting a metric ton of a GHG to the atmosphere in a given year.”<sup>41</sup> From a lifecycle perspective, accounting for the full social cost of a unit of methane must include the upstream, midstream, and downstream emissions taken together.

Turning on a gas stove creates a cascading set of supply chain emissions and groundwater contamination, often beginning at a hydraulic fracking site<sup>42</sup> and releasing pollutants known to damage the climate and cause cancer, cardiovascular disease, asthma, and birth defects along the entire journey that ultimately delivers the demanded heating therms to end-user appliances. The gas stove is one terminus of the fracking pipeline, releasing nitrogen oxides, carbon monoxide, fine particulate matter, and benzene.

A recent study of upstream oil and gas emissions in the United States quantifies the magnitude of both public health and climate costs. Buonocore and colleagues estimate the total health impacts of air pollution emissions from oil and gas production (excluding

39 EPA, [Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2021](#) (2023), Table 3-66, p. 3-95.

40 Claire Schollaert et al., “[Natural Gas Leaks and Tree Death: A First-Look Case-Control Study of Urban Trees in Chelsea, MA U.S.A.](#),” *Environmental Pollution* (August 2020).

41 EPA, [Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances](#) (September 2022).

42 For the most recent Compendium review of the risks and harms of fracking for public health and the climate, see Concerned Health Professionals of New York and Physicians for Social Responsibility, [Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure \(Ninth Edition\)](#) (October 2023).

downstream and midstream emissions) at \$77 billion annually in 2016.<sup>43</sup> Over 99 percent of this cost comes from mortality, with the death of 7,500 persons attributable to air pollution. In addition to these direct health impacts, the researchers value the total estimated climate impact at \$11.1 billion (low of \$4.3 billion, high of \$15.5 billion),<sup>44</sup> for a total climate and health impact of \$88.3 billion (see Table 2).

These numbers underestimate “the full health costs because they omit downstream combustion of oil, downstream and indoor combustion of natural gas, and potential health impacts of indoor gas leaks.”<sup>45</sup> The study also finds that, although oil and gas emissions have the greatest impacts on air quality and health in states with significant production practices (e.g., LA, OH, OK, PA, TX), upwind states with little oil and gas extraction activity also experience substantial impacts (e.g., IL and NY).

**Table 2: Valuing health & climate costs from U.S. gas & oil extraction in 2016**

Health costs	Value
Premature deaths (7,500 cases due to PM <sub>2.5</sub> , NO <sub>2</sub> , & ozone)	\$77 billion
Asthma and other respiratory (414,283 incidents or related medical interventions due to PM <sub>2.5</sub> , NO <sub>2</sub> , ozone)	\$199.2 million
Heart attacks (270 cases due to PM <sub>2.5</sub> , NO <sub>2</sub> )	\$19 million
Climate costs	Value
Gas	\$8.3 billion (of which \$7 billion is from methane emissions)
Oil	\$2.8 billion (of which \$2 billion is from methane emissions)
<b>Total health and climate costs</b>	<b>\$88.3 billion</b>

Source: Buonocore et al., 2023; value in 2016 dollars.

These health and climate cost valuations have significant financial and economic implications:

- » First, they confirm that the market price of gas is much lower than it should be. If the price built in not just the cost of extracting, processing, and transmitting the gas (its private costs) but also the social costs of gas, then the price of gas would need to increase substantially. In fact, it would essentially double (see Figure 5).
- » Second, because the market price is artificially low relative to its true cost (private plus social costs), both investment and consumption decisions become distorted.

43 Jonathan J. Buonocore et al., “[Air pollution and health impacts of oil & gas production in the United States](#),” Environmental Research: Health (2023).

44 This estimate is based on calculations by the U.S. Interagency Working Group on the Social Cost of GHGs (see “[Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide: Interim Estimates under Executive Order 13990](#)” (February 2021)). Buonocore notes that the 2021 estimates for the U.S. Social Cost of GHGs, and all other estimates of the Social Cost of Carbon, incorporate only the impact on climate change. That is, they **do not include** the additional air pollution-related health impacts. Since the publication of Buonocore’s paper, the Working Group’s estimates have been updated and finalized: [Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances](#) (November 2023). The new estimates are higher than the prior estimates which means that the climate costs estimated by Buonocore are likely underestimated.

45 Jonathan J. Buonocore et al., “[Air pollution and health impacts of oil & gas production in the United States](#),” Environmental Research: Health (2023), p. 11.

For example, for the gas utility, the costs of replacing an old pipeline or extending a gas pipeline to a new customer appear less expensive than they truly are. Similarly, for a consumer deciding whether to purchase a particular gas appliance, the price of the product is lower than it would be if the costs of the greenhouse gases and pollutants that the appliance will release were included in the price of the appliance (much like a bottle or can deposit).

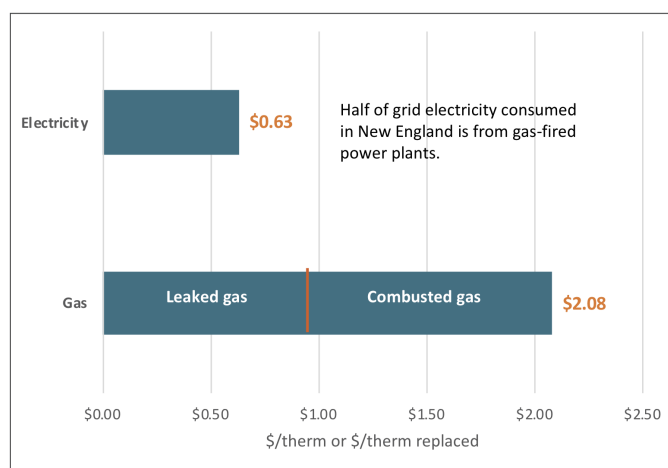
- » Finally, if the prices of gas and electricity were adjusted to account for their social costs, even when the generation of electricity relies heavily on gas, the adjusted price of gas would far exceed the adjusted price of electricity.<sup>46</sup> Pressure on utilities to transition away from gas would increase markedly and the speed of electrification would accelerate. Corrective policies should be considered since at stake ultimately are the urgent timelines for meeting the ambitious building decarbonization goals set by many states and cities.

### Pricing in the social costs of fossil gas and electricity in Boston, MA

Data and metrics provided by Mark Sandeen

The social cost of a heat pump in Boston that replaces the same therm of gas heating is \$0.63 per therm of methane (CH<sub>4</sub>). The social cost of a therm of fossil gas is three times higher at \$2.08, with the gas system's leakage rate accounting for nearly half of this amount. Switching from gas to electricity, therefore, lowers the social cost of heating a home by 70%. Over time, as the electric grid relies increasingly on renewables, the social cost of electricity will decline.

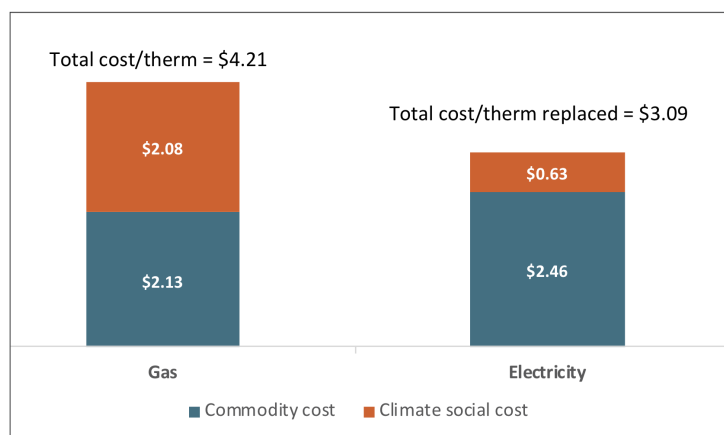
Figure 4: Relative social costs of gas and electricity in Boston, 2023



46 Severin Borenstein and James B. Bushnell, "[Headwinds and Tailwinds: Implications of Inefficient Retail Energy Pricing for Energy Substitution](#)," Environmental and Energy Policy and the Economy (2022).

The social cost of gas (both leaked and combusted) is \$2.08 per therm—roughly equivalent to the cost of the fuel (\$2.13/therm). The “total” cost of fossil gas is the sum of the commodity cost plus the social cost, or \$4.21. Accounting for the social cost roughly doubles the cost of gas. In comparison, on a total cost basis, electricity (at \$3.09/therm) is less expensive than gas (at \$4.21/therm) by 27%.

**Figure 5: Relative commodity and social costs of gas and electricity in Boston, 2023**



**Assumptions:** Winter 2022 load-weighted gas price of \$2.13 therm; ISO-NE cost of electricity in October 2023 of \$0.28/kWh; [2.7 % leakage rate](#) for gas; 20-year global warming potential; social cost for carbon dioxide and methane of \$208 and \$1,950, respectively; U.S. EPA emissions factor for leaked methane of 366.14 pounds CO<sub>2</sub>e/therm; ISO-NE 2021 load-weighted marginal emission rate of 0.758 pounds CO<sub>2</sub>/kWh.

From the gas side, Section IV.B reviews some of the policies for addressing this market failure: corrective taxes, fees, and pollution quotas; governmental methane reduction programs that enforce emission and abatement standards; and subsidies that incentivize the purchase and installation of cleaner space and water heating appliances.

On the electric side, an important area of policy development is alternative rate designs that improve the economics of electric appliances and equipment and build in equity considerations.<sup>47</sup> The fact that electricity has lower social costs than gas (as shown in Figures 4 and 5) can be leveraged to reform retail electricity rates in order to drive the adoption of heat pumps and electric vehicles, and support the reduction of electricity usage at peak times.

Heat pumps without subsidies have high initial capital costs and, in some parts of the country, their operating costs can be higher than fossil gas boilers and furnaces. What impact could alternative retail electric rate structures have on the economics of heat pumps vs. fossil gas boilers and furnaces? Using data on gas and electricity usage for residential customers of an investor-owned utility in the United States, Sergici and colleagues find that, by reforming the traditional cost-based rate design consisting of a

<sup>47</sup> Tim Schittekatte et al., “[Reforming retail electricity rates to facilitate economy-wide decarbonization](#),” *Joule* (May 2023). Two states that have made significant strides in this direction are California and Hawaii.

fixed charge and flat volumetric charge, the operating cost gap between heat pumps and natural gas heating flips for all consumers from positive to negative. Switching to a time-of-use day/night structure or a demand-based structure results in even larger negative operating cost gaps. “These results reflect the fact that all of the alternative rate designs are better aligned with the marginal cost of generating and delivering power, compared to the default residential rate design, which typically is not.”<sup>48</sup>

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48 Sanem Sergici et al., [Heat Pump-Friendly Cost-Based Rate Designs, A White Paper from the Retail Pricing Task Force](#), Energy Systems Integration Group (2022), p. 16.

### III. Gas Industry Response to the Changing Economics of Gas

America's shift to clean energy is underway, propelled by three key factors supporting a rapid move away from using gas:

- » Technological advances in heating, cooling, and renewable energy production, including increasingly cost-effective clean, electric alternatives for space and water heating
- » State and local climate policies
- » Unprecedented federal and state incentives

For the building sector, these factors combine to support widespread electrification via heat pumps complemented with efficiency measures such as weatherization and advanced demand management.<sup>49</sup>

Progress is also being made across the country in deploying neighborhood- or community-scale thermal energy networks that connect multiple buildings with ambient temperature loops. These networks can harness thermal reservoirs, such as the temperature of bedrock or local bodies of water, and waste heat from data centers or sewage treatment facilities. Using ground-source heat pumps powered by electricity, these networks can provide highly efficient heating and cooling along with multiple social and economic benefits.

Cities and states are grappling with how to reduce greenhouse gas emissions and meet climate goals. In many states, integrated sector-specific strategies to achieve mandated greenhouse gas emissions reductions are still in the planning or study phase. These emerging decarbonization roadmaps typically remain disconnected from the business plans of local gas distribution companies (LDCs, i.e., gas utilities), the majority of which are part of larger investor-owned energy utilities. LDC business plans continue to assume accelerated replacement of existing gas distribution infrastructure (under state programs to replace vintage gas pipelines) as well as new load growth (i.e., extensions of existing gas delivery systems to accommodate new customers). This business-as-usual approach creates a concerning paradox: at the same time that science and public policy are moving away from fossil fuels, LDCs are still making substantial investments in their gas distribution systems, committing future generations of ratepayers to cost recovery into the next century and digging states deeper into fossil-fuel dependency.

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<sup>49</sup> Demand management refers to smart thermostats, connected appliances, and behind-the-meter storage and generation to reduce peak building demand and shift demand to times of high renewable energy generation.



## A. Changing economics of gas

Market forces shaping the economics of gas, meanwhile, are changing rapidly. The future is likely to bring:

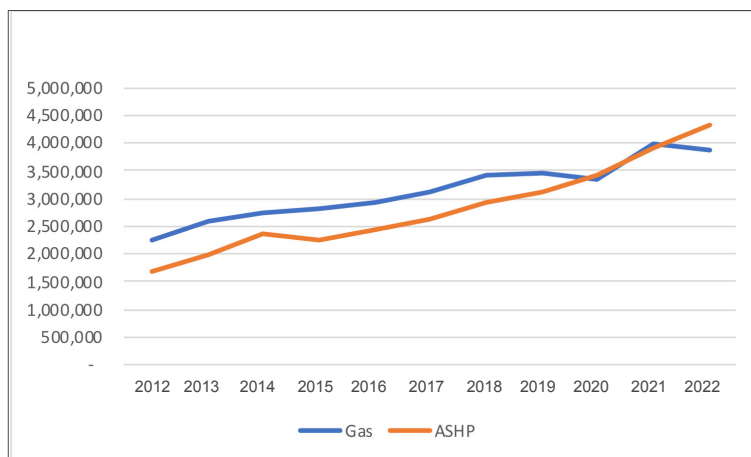
- » **Fewer gas customers and lower demand for gas.** Over the next 25 years, greenhouse gas reduction policies will decrease the demand for gas, and the gas customer base will decline. This shift will require gas delivery costs to be spread across fewer ratepayers, of whom an increasing proportion will likely be lower-income households, as they may lack the resources to invest in energy-efficient technologies that can have significant upfront costs. The burden of higher gas bills will also be borne by renters who have little control over decision making and investments related to the buildings in which they live.
- » **Higher gas costs.** Energy prices will increasingly favor renewables, encouraging fuel-shifting away from gas to electricity. Furthermore, the costs of operating safe and reliable gas delivery systems have been increasing, pushing up operations and maintenance expenditures.
- » **Growing risk of stranded gas infrastructure assets.** Downward revisions in the economic lifetime, capacity utilization, and/or profitability of gas infrastructure increases the risk of unrecoverable gas investment costs (i.e., undepreciated balances).<sup>50</sup> The likelihood of these downward revisions is perhaps most acutely tied to three current “threats” to the gas industry: the prospects of stepped-up climate policy further limiting GHG emissions and gas use, utility regulation that drives a downsizing of gas distribution networks, and continued breakthroughs in renewable technologies.

Momentum toward this new future is building, bringing growing financial challenges and regulatory uncertainty to the gas industry. Sales of air source heat pumps (ASHPs) that provide electrically-powered, highly efficient heating and cooling are accelerating: from 2013 to 2021, ASHP sales in the Northeast increased from just under 50,000 units to over 225,000 on an annual basis. In 2022, heat pumps topped gas-powered furnaces in total units sold in the U.S. (see Figure 6). Overall, Americans bought more than 4.3 million heat pump units in 2022, compared to roughly 3.9 million methane gas furnaces, with the greatest concentration in the Southeast, where gas connections are less common. The adoption of ASHPs is also growing in colder climates as the technology improves and consumer awareness increases.

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<sup>50</sup> As the need for gas infrastructure diminishes, certain gas assets may no longer be “used and useful” even though their full cost has not been recovered from ratepayers. This stranding of remaining asset value leads to assets being removed from the LDC’s rate base, resulting in reduced rate recovery and shareholder earnings.

**Figure 6: Heat pump sales in U.S. compared to gas furnaces, 2012–2022**

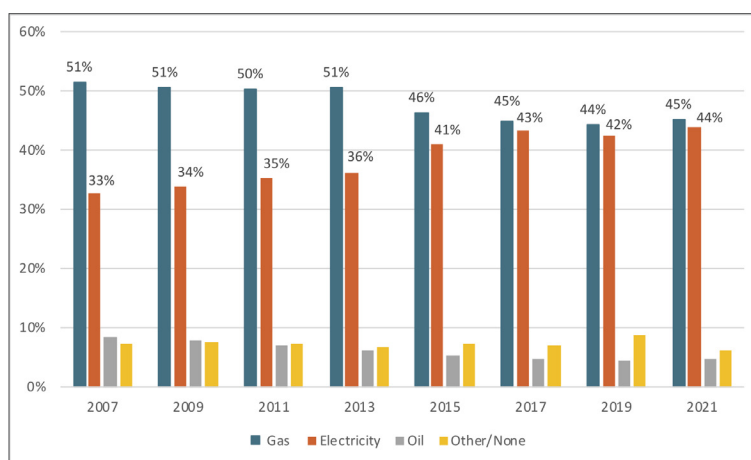


Source: [Air-Conditioning, Heating, and Refrigeration Institute](#).

Additionally, the market share of gas as a heating fuel is declining for both new construction and the housing stock as a whole:

- » Electric heating has become the most popular form of heating for new single- and multi-family residential construction. From 2000 to 2021, the share of new housing units heated by gas fell from 65 percent to 48 percent, while electricity’s share increased from 32 percent to 52 percent.<sup>51</sup>
- » The market share of gas for heating has been declining for 15 years in existing residential housing (single- and multi-family). The share of households heated by gas fell from 51 percent to 45 percent from 2007 to 2021, while electricity’s share increased from 33 percent to 44 percent (see Figure 7).<sup>52</sup>

**Figure 7: Market share of occupied housing units by heating fuel, 2007-2021**



Source: [AGA](#)

51 AGA, Table 10-4: [Market Share of Private Housing Completions by Heating Fuel, 2000-2021](#) (U.S. Bureau of the Census data analyzed by AGA).

52 AGA, Table 10-5: [Number of Occupied Housing Units by Type of Heating Fuel and Census Region, 2007-2021](#) (U.S. Bureau of the Census data analyzed by AGA).

Evidence of declining gas demand at the state level is building. One example is California—one of the most gas-dependent states in the country, with over 80 percent of households depending on gas for at least some use. According to the California Public Utilities Commission, “Since its peak in 2000, gas demand in California has declined by about 17 percent and is currently declining at the rate of about 1.1 percent annually. Recent local and state policy developments make it likely that these trends will continue or accelerate over the next 10-20 years.”<sup>53</sup> On the global front, the International Economic Agency forecasts that fossil fuel demand will peak before the end of this decade and warns that oil and gas investments are no longer “safe or secure” for countries or consumers.<sup>54</sup>

Finally, two upstream changes are disrupting the distribution system.<sup>55</sup> First, electric power generation from gas-fired power plants in the U.S. likely peaked in summer 2023 and is beginning a structural decline, thereby weakening a major source of demand for fossil gas.<sup>56</sup> Second, the surging export market for liquefied gas is “turning what was once a domestic energy source into an internationally traded commodity,”<sup>57</sup> resulting in upward pressure on U.S. domestic gas prices and greater exposure to international price swings.<sup>58</sup> Up to half of U.S. gas production could be headed overseas, although the timing may be affected by the Biden Administration’s temporary halt in January 2024 on new LNG export projects, pending further DOE environmental impact evaluation.

These forces are disrupting the previously favorable economics for the domestic gas distribution industry. Amplifying this disruption is uncertainty about how state and federal regulation will unfold. Regulators in several states are moving toward requiring gas utilities to engage in long-term planning for their gas distribution networks with a view to at least curtailing the growth of new capital spending in light of the growing risk of stranded gas assets. At the federal level, new regulations designed to require gas system operators to reduce methane emissions and incorporate environmental and climate concerns into pipeline management are working their way through to implementation. In sum, the urgency to move off gas to sustainable solutions is not only a climate, health, and safety imperative; it is also becoming a market-driven necessity and a matter of growing financial vulnerability for gas utilities as the prospects of recovering sunk gas infrastructure costs become more paramount.

## B. Gas industry response: Pipeline replacement, new load growth, and alternative gases

Current regulatory practices shelter the operations of gas companies from legislative climate mandates until they are translated into regulatory frameworks and procedures. In other words, the regulatory processes in place heavily favor the status quo, and any

53 CPUC, [“Assigned Commissioner’s Phase 2 Scoping Memo and Ruling, 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”](#) (August 1, 2023), p. 2.

54 IEA, [World Energy Outlook 2023](#) (October 2023).

55 Concerned Health Professionals of New York and Physicians for Social Responsibility, [Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking and Associated Gas and Oil Infrastructure \(Ninth Edition\)](#) (October 2023), pdf p. 17.

56 EIA, [Short-Term Energy Outlook, Forecasts](#) (November 7, 2023).

57 Chris Martinez, [“LNG exports raise natural gas prices for Americans,”](#) Center for American Progress (November 6, 2023).

58 EIA, [“Issue in Focus: Effects of Liquefied Natural Gas Exports on the U.S. Natural Gas Market”](#) (May 23, 2023).

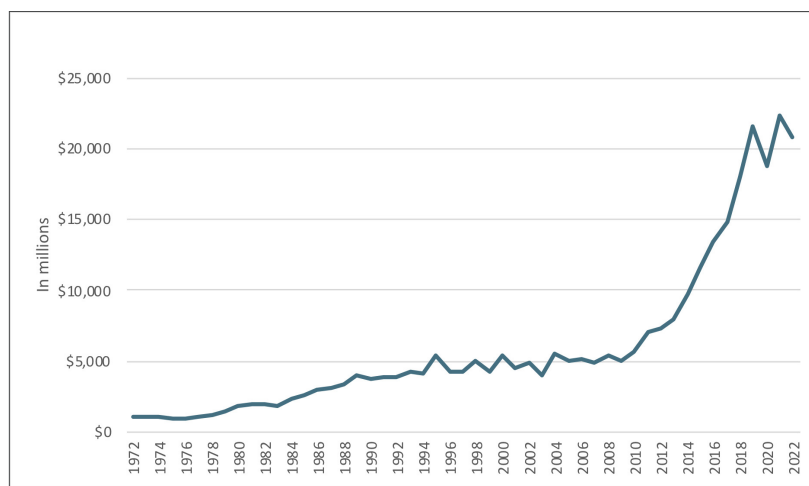
change typically occurs slowly and conservatively, often following lengthy adjudicatory hearings. As a result, even though many jurisdictions have strong mandates in place to reduce greenhouse gas emissions, and even though the energy transition poses existential financial risk to companies that are heavily exposed to fossil fuels, the gas industry continues to invest heavily in its distribution system, replacing vintage mains and service lines as well as extending service to new customers and creating new load growth.

Gas companies are also banking on repurposing their gas distribution systems for “alternative gases” such as hydrogen, synthetic methane gas, and “renewable natural gas” (i.e., methane derived from biomass operations such as landfills and animal farms). However, they are failing to make a viable business case for this shift based on current scientific and economic realities.

### Accelerated investment in gas distribution infrastructure

In the past decade, gas utilities have rapidly increased capital spending on distribution infrastructure. From 2011 to 2022, this spending tripled from roughly \$7 billion per year to \$20.9 billion, according to data from the American Gas Association (see Figure 8). Over the last decade, gas distribution capital spending totaled \$160 billion. These investments have been spurred and supported by state programs that incentivize gas utilities to replace vintage distribution pipeline infrastructure. According to the National Association of Regulatory Utility Commissioners (NARUC), 41 states and the District of Columbia have developed rate mechanisms, such as surcharges or “riders,” to encourage gas companies to replace older or problematic pipes within their distribution systems.<sup>59</sup> These riders (also known as “capital trackers”) are added to customer bills, allowing utilities to recover replacement costs annually without having to wait for the next rate case.

**Figure 8: Accelerated spending on America's aging gas distribution system, 1972-2020**



Source: [AGA](#)

<sup>59</sup> NARUC, [Natural Gas Distribution Infrastructure Replacement and Modernization: A Review of State Programs](#) (January 2020).

Initially, pipeline replacement programs were created to address safety and reliability concerns, mainly resulting from the advancing age of the oldest cohorts of gas pipeline. But the recent period of accelerated investment was also heavily tied to advancements in fracking technology. Beginning around 2013, vast amounts of previously unrecoverable or uneconomic gas became available at much lower costs, resulting in abundant supplies and moderate prices. Fossil gas was positioned as an abundant fuel source offering key economic and environmental benefits compared to coal and oil. The industry focused on encouraging consumers to use more gas, adding new customers, and expanding industrial applications.<sup>60</sup> As a result, upgrading and modernizing distribution networks became economically attractive.

A series of gas pipeline accidents also spurred this acceleration, supported by a 2011 DOT/PHMSA “Call to Action” for faster repair, rehabilitation, and replacement of the highest-risk pipeline (i.e., cast and wrought iron).<sup>61</sup> PHMSA specifically encouraged comprehensive reviews of gas distribution networks and replacement programs, requesting that state agencies consider enhancements to replacement programs.

Each year, the gas industry also invests in new pipelines to accommodate load growth and capacity additions to serve increased demand from existing customers. These extensions are typically heavily subsidized by ratepayers via line extension allowances that are paid for through an increase in gas rates. These funds cover some or all of the costs to connect new customers and encourage them to purchase gas equipment and appliances. (See Section V.A for more information.)

It should also be noted that, in 2023, the federal government began funding pipeline replacement projects for publicly-owned gas systems. The Infrastructure Investment and Jobs Act (IIJA, P.L. 117-58) provides for a new federal grant program—the Natural Gas Distribution Infrastructure Safety and Modernization (NGDISM)—to replace aging pipeline in municipally and community-owned gas distribution systems in order to improve public safety, protect public health, and reduce methane emissions.<sup>62</sup> Administered by PHMSA, \$200 million annually has been appropriated through FY2026, with the first grants announced in April 2023 (\$196 million in grants for 37 projects spread across 19 states).<sup>63</sup> This funding can be used for advanced leak detection and repair equipment, though the focus remains on pipe replacement, adding federal support to the gas industry’s push to strengthen distribution systems for the delivery of more gas.

The opportunity cost of these continued investments in gas infrastructure is often neglected. Regulatory proceedings require gas companies to look ahead five years at most, without attention to the considerable aggregate costs of these investments over time. But these long-term investments are paid for over decades by ratepayers and create new fossil fuel-based assets with an economic life of 50 to 60 years. Huge sums are being spent on gas infrastructure at a time when there is great urgency to invest in

60 Kyle Rogers, “[Expanding the Reach of Natural Gas Infrastructure](#),” AGA Testimony before the House Committee on Energy and Technology (2013). According to an [AGA compendium](#) (2014), by 2013, there were already 34 state pipeline replacement programs in place.

61 DOT, PHMSA, [Pipeline Replacement Background](#).

62 DOT, PHMSA, [Natural Gas Distribution Infrastructure Safety and Modernization Grants](#).

63 PHMSA, [FY 2022 Natural Gas Distribution Infrastructure Safety and Modernization Grant Awards](#).

and scale renewable, non-emitting electrification solutions and thermal energy systems. Furthermore, continued gas infrastructure investments raise the prospect of significant cost recovery issues and financial risk for both utility owners and gas customers. Even if much of the gas infrastructure remains in place by 2050, it will likely be supplying significantly lower volumes of gas due to warmer temperatures, improved building energy efficiency, and customers migrating to full electric space and water heating and thermal energy sources. Accelerated investment now in gas infrastructure heads rapidly in the opposite direction of other energy markets.

As they swim against the tide of electrification, gas utilities and their regulators are hard pressed to make a feasibility case for how continued high levels of investment in the existing gas distribution system align with city and state decarbonization goals or how they will be cost effective or affordable for gas customers.<sup>64</sup> With the focus on the climate-damaging role that pipeline leaks play, gas utilities now routinely point to the methane reduction impact of their pipeline replacement activity, but pipeline replacement is unlikely to be a cost-effective way to reduce emissions. Napoleon and Hopkins, for example, argue that “an approach based on building retrofits, electrification, and pipeline retirement could reduce emissions at a cost per ton that is 77 percent less expensive than the cost per ton of the MRP [main replacement pipe], while delivering co-benefits of lower energy bills and increased public health and comfort for building residents.”<sup>65</sup>

Table 3 presents recent independent studies that investigate the cumulative costs of gas utility pipeline replacement initiatives currently underway in various jurisdictions. These capital investments are creating new, long-lived gas plant at a time when gas use in buildings is tipping towards structural decline. This body of research finds that massive long-term expenditures are required to maintain or “modernize” existing gas systems and demonstrates that this spending requires untenable rate increases over time. As customers leave the gas system to adopt cleaner, more efficient electric heating, rates will need to increase even further to cover lost customer revenue. Several of the studies also underscore the growing risk exposure of gas utility investments to asset stranding, documenting sharp increases in the value of undepreciated gas distribution system assets on utility balance sheets.

64 Steven Nadel, [Impact of Electrification and Decarbonization on Gas Distribution Costs](#), ACEEE (June 2023).

65 NY PSC, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Gas Service, [Direct Testimony of Alice Napoleon and Asa Hopkins PhD](#) (download PDF) on behalf of Natural Resource Defense Council (May 20, 2022), p. 6.

<b>Table 3: Studies documenting gas utility pipeline replacement program costs</b>			
<b>City/state (program/utilities)</b>	<b>Study</b>	<b>Program goals &amp; timeframe (est. cost per mile)</b>	<b>Long-term cost estimates</b>
<b>Chicago</b> (Peoples Gas: System Modernization Program)	<a href="#">Scarr &amp; Orcutt</a> (2019)	Replace ~2,800 miles by ~2040 (\$5.7 million)	\$8-\$11 billion
<b>Idaho, Oregon, &amp; Washington</b> (Avista, PSE, Cascade, Intermountain)	<a href="#">Sightline Institute</a> (2023)	Replace 1,359 miles over next decade	\$1.3 billion in capex
<b>Maryland</b> (Strategic Infrastructure Development & Enhancement (STRIDE)/3 largest gas utilities)	<a href="#">MD Office of People's Counsel</a> (2023)	Replace ~1,550 miles by 2043 (\$2.6-\$2.9 million for Baltimore Gas & Electric)	\$53.2 billion from 2024-2100, including non-STRIDE gas processing capex
<b>Massachusetts</b> (Gas System Enhancement Program/all investor-owned utilities)	<a href="#">Seavey</a> (2023)	Replace ~6,200 main miles from 2015-2039 (\$2.2 million for CY2023) <sup>66</sup>	\$42 billion (\$2022)
<b>Minnesota</b> (3 largest utilities)	<a href="#">Larkin-Connolly &amp; Parcels</a> (2023)	Assumes capex necessary to achieve stated rate base growth targets.	\$1 billion annual capex by 2030; \$19.2 billion total from 2023-2040
<b>New York</b> (Pipeline replacement programs of 6 largest utilities)	<a href="#">Synapse Energy Economics</a> (2023)  <a href="#">Building Decarbonization Coalition</a> (2023)	Replace 7,000+ miles & 190,000 services over next 20 years (\$6.177 million including return to investors)	\$150 billion cumulative revenue requirement through 2120  Presents per-customer revenue requirement for alternative future-of-gas scenarios
<b>Philadelphia</b> (Philadelphia Gas Works: 2 cast iron programs plus other mains)	<a href="#">Seavey</a> (2023)	Replace ~1,452 miles by 2058 (\$2.1 million)	\$6-\$8 billion
<b>Washington, DC</b> (Washington Gas: PROJECTpipes)	<a href="#">Synapse Energy Economics</a> (2023)	Replace ~400 miles over next 30 years (\$9.1 million for cast iron & steel main)	\$8-\$12 billion

At the national level, if the current gas utility spending levels reported by the American Gas Association continue (see Figure 8), U.S. gas ratepayers would incur over \$1 trillion (\$2022) in payment obligations for distribution infrastructure investments between 2015 and 2040 (direct costs plus rates of return for investor-owned companies).<sup>67</sup> About one third of this amount (\$347 billion) is already locked in to gas utility rate bases and will exert considerable upward pressure on customer gas rates over the next fifty years. The remainder—\$698

<sup>66</sup> Cost per mile figure calculated by author as a weighted average for 6 utilities participating in GSEP.

<sup>67</sup> Assumptions: historical capex as per Figure 8 continued at the 2022 rate through 2039, 53-year depreciation period (weighted average of 60 years for mains and 40 years for services assuming 2/3 of spending for mains and 1/3 for services), 8.5% pre-tax weighted average cost of capital, and 2% escalation rate.

billion—is the future capital cost (inclusive of investor rates of return) of continuing to replace distribution pipeline at the current annual rate of roughly \$21 billion from 2023 to 2040, at which point many accelerated pipeline replacement programs are due to end. These costs would be recoverable through the end of the century. Continuing gas utility capital spending through 2050—the net-zero target date for much of the country—would add another \$325 billion to the nation’s gas infrastructure bill, bringing total cumulative spending \$1.4 trillion (\$2022) and pushing out cost recovery to just past the year 2100.

Grappling with the pipeline replacement programs responsible for these mounting long-term gas system costs should be of paramount concern to regulatory commissions. Studies investigating these programs identify several key obstacles and concerns:

- » **Lack of transparency regarding cumulative spending costs hides economic realities.** Because regulatory frameworks typically allow for no more than a five-year lookout for multi-decade pipeline replacement programs, the full impacts of pipeline replacement capital spending on customer energy bills and on gas utility financial viability are not subject to adequate analysis and evaluation. Furthermore, a comprehensive overview of pipeline replacement costs is impeded by splintered dockets that parcel out the facts and issues, allowing gas companies to argue on technical grounds that an energy transition issue is beyond the scope of a particular docket. For example, electrical utility forecasts sometimes predict significant decline in gas consumption, but gas-related dockets don’t necessarily include this information.
- » **Pipeline is often replaced largely wholesale with a generalized appeal to “safety and reliability” rather than according to clear protocols that prioritize the riskiest pipes or pipes with the largest leak volumes.** As recently stated by the Illinois Commerce Commission, “The question is not whether pipeline replacements generally improve safety and reliability, but what types of pipes are to be replaced, to what degree safety and reliability are affected, at what pace, and at what cost.”<sup>68</sup>
- » **Regulators rarely require gas utilities to consider alternatives (NPAs).** Advances in technology offer solutions that are equally, if not more, cost-effective than pipeline replacement.
- » **Regulators rarely require gas utilities to consider climate and health impacts (greenhouse gas emissions or air pollution emissions).** Regulators often claim that, under current law, they are not allowed or required to consider climate or health impacts.
- » **Regulatory and planning processes for gas are not coordinated with the electric system.** As a result, the default transition pathway is necessarily unmanaged and requires the existing gas system, with all its costs and inefficiencies, to be maintained intact.
- » **Planning processes for gas are overwhelmingly conducted by gas utilities.** This is a conflict of interest, often resulting in plans that are not aligned with state goals and ratepayer interests.

68 ICC, [Ameren Illinois Company, Order, Docket P2023-0067](#) (November 16, 2023), p. 90.



- » **Pipeline replacement paves the way for alternative fuels.** Further investments in gas infrastructure enable the gas industry's push to blend renewable natural gas (RNG), certified gas, and hydrogen into existing distribution systems.
- » **Stranded gas distribution assets are a significant risk.** Continued gas infrastructure investment activity creates infrastructure that may have to be retired or decommissioned before its fully burdened cost is recovered from ratepayers.
- » **Affordability and equity concerns are a growing problem.** The costs of maintaining a gas distribution system will most likely fall on a shrinking number of gas customers, particularly renters and low-income ratepayers without the ability to invest in energy efficiency or clean and renewable energy systems. These ratepayers are often already energy burdened, spending a much larger proportion of their income on energy bills compared to the majority of ratepayers.
- » **Pipeline replacement is not necessarily the most cost-effective way to reduce emissions.** Energy efficiency and non-combusting solutions are widely accepted as the best tool for cutting greenhouse gas emissions from buildings.

### Alternative gases

The gas industry is working to stay in business and develop new growth opportunities that rely on non-fossil gases marketed as lower-carbon or “decarbonized.” Blending alternative gases into gas in the distribution system, it claims, will decrease emissions. The main alternative fuels being pursued by the gas industry are hydrogen and RNG (i.e., pipeline-quality gas obtained from biomass or the decomposition of other organic matter). According to the American Gas Association, adding hydrogen and RNG into gas distribution systems is a “critical component of our nation’s ability to reach ambitious greenhouse gas reductions goals.”

The gas industry’s “decarbonization” strategy will require the continued use of and investment in the gas system. It will also discourage high rates of electrification and building efficiency that would otherwise decrease gas consumption. This strategy preserves the utility’s existing business model and is reinforced by a public relations campaign that stokes wariness over the need to rapidly transition away from fossil fuels. It also emphasizes the need to keep the gas system in place for resiliency and backup while warning of the enormous costs of change, and equating electrification and RNG as future building heat options.

In contrast, scientific experts and analysts challenge not only the feasibility of decarbonizing the gas grid with replacement gases, but also the economic and social costs. They raise concerns about the inefficiency and expense of alternative gases, higher life-cycle greenhouse gas emissions impacts, limited supply, public health and safety impacts, and other problems that delay or distract from transitioning to non-emitting energy sources.

**Renewable Natural Gas.** RNG is derived from biogas captured from organic wastes such as from farms (animal manure and agricultural residues), landfills (food waste), forest and forest product residues (biomass), agricultural crops (such as maize, grass, and wheat),

and wastewater treatment facilities.<sup>69</sup> The resulting gas is then processed to create RNG, a fuel that is interchangeable with fossil gas and can be transported in the same pipes and used to power the same equipment and appliances.<sup>70</sup>

The gas industry views RNG as carbon neutral and fully compatible with the U.S. pipeline system.<sup>71</sup> Growing numbers of regulatory commissions are permitting utilities to offer RNG (or related renewable energy credits) to their customers, sending the message that “RNG provides an environmentally preferable alternative to fossil gas.”<sup>72</sup> But research has established that relying on RNG as an answer to decarbonization has several “fatal flaws”:<sup>73</sup>

- » **Availability:** Even the most optimistic estimates indicate that RNG could fill only a small proportion of current gas usage nationwide.
- » **Cost:** RNG is very expensive compared to other energy sources, in part because it takes energy to process biogas into RNG. Furthermore, RNG is not necessarily a cost-effective way to reduce emissions compared to pipeline retirement paired with electrification retrofits. Napoleon and Hopkins estimate that by 2050 “non-fossil gas reduces emissions at a cost of between \$448 per ton...and almost \$1,600 per ton” compared to about \$184 per ton for electrification retrofits and pipeline retirement, which also provide other benefits, such as “lower energy bills for residents, improved occupant comfort, elimination of toxic air pollution...and lower stranded cost risk.”<sup>74</sup>
- » **Carbon intensity and health impacts:** The carbon footprint of RNG varies considerably according to, among other things, its feedstock, transportation methods, and accounting frameworks.<sup>75</sup> Only a limited amount has a small carbon footprint or produces lifecycle carbon reductions, and even then there may be health and environmental impacts that are deleterious.<sup>76</sup> Recent research shows that methane emissions from RNG supply chains are substantial and severely underestimated.<sup>77</sup> The vast majority of RNG is likely to mimic the carbon footprint of fossil gas, and when injected into gas distribution systems, RNG will leak from pipes and behind the meter just as fossil gas does. In terms of health impacts, the harmful air pollution caused by burning RNG is no less than that caused by fossil gas.<sup>78</sup>

69 Biogas is composed of methane, carbon dioxide and other impurities and can itself be used as a fuel to generate electricity or heating, for example, at the site of production, but is not compatible with pipeline distribution systems.

70 Laura Feinstein and Eric de Place, “[The four fatal flaws of renewable natural gas](#)” Sightline (March 9, 2021); NY PSC, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Gas Service, [Direct Testimony of Alice Napoleon and Asa Hopkins PhD](#) (download PDF) on behalf of NRDC (May 20, 2022), p. 40.

71 AGA 2023 Playbook, “[Innovation](#).”

72 NY PSC, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Gas Service, [Direct Testimony of Alice Napoleon and Asa Hopkins PhD](#) (download PDF) on behalf of NRDC (May 20, 2022), p. 44.

73 Laura Feinstein and Eric de Place, “[The four fatal flaws of renewable natural gas](#)” Sightline (March 9, 2021).

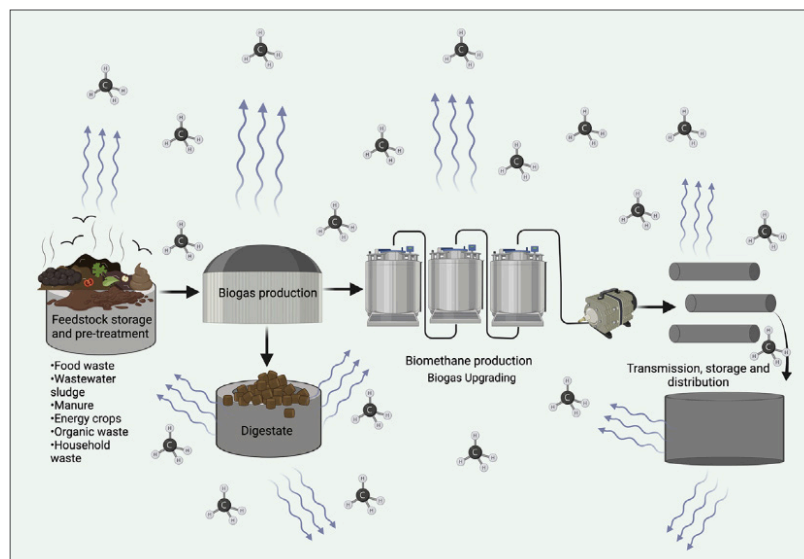
74 NY PSC, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Gas Service, [Direct Testimony of Alice Napoleon and Asa Hopkins PhD](#) (download PDF) on behalf of NRDC (May 20, 2022), p. 47.

75 NY PSC, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Gas Service, [Direct Testimony of Alice Napoleon and Asa Hopkins PhD](#) (download PDF) on behalf of NRDC (May 20, 2022), pp. 41-42.

76 Emma Foehringer Merchant, “[A battle is underway over California’s lucrative dairy biogas market](#),” Inside Climate News (December 28, 2023).

77 Semra Bakkaloglu et al., “[Methane emissions along biomethane and biogas supply chains are underestimated](#),” One Earth (2022).

78 Jonathan J. Buonocore et al., “[A decade of the U.S. energy mix transitioning away from coal: historical reconstruction of the reductions in the public health burden of energy](#),” Environmental Research Letters (2021).

**Figure 9: Emissions from the RNG supply chain**

Source: Semra Bakkaloglu et al., "[Methane emissions along biomethane and biogas supply chains are underestimated.](#)"

While it can benefit certain niche industrial applications,<sup>79</sup> broadly positioning RNG as a climate-friendly replacement for fossil gas is likely to slow decarbonization and provide an illusory reason not to decommission gas infrastructure and instead to continue investing in it.

**Hydrogen.** According to the American Gas Association, "Gas utilities will play a critical role in building a clean hydrogen economy. The U.S. possesses the most extensive gas pipeline delivery network in the world, and extensive research and testing is underway now to make leveraging this infrastructure to deliver clean hydrogen in the future a reality."<sup>80</sup> In a major report on the future of hydrogen, the Fuel Cell & Hydrogen Energy Association, coordinating twenty fossil-fuel related companies and organizations, advances a "gas grid hydrogen" pathway that would deliver blended gas that is half hydrogen, half methane by 2050.<sup>81</sup> To date, U.S. gas utilities have announced more than three dozen hydrogen projects,<sup>82</sup> evidence that "the industry is starting to execute on its plans to demonstrate the fuel's ability to decarbonize distribution systems."<sup>83</sup>

In contrast, the weight of the independent scientific community's assessment is that, like RNG, hydrogen is neither a scalable building decarbonization solution nor a viable, cost-effective reason to invest in gas infrastructure. A recent meta-review of 54 independent studies assessing the scientific evidence for using hydrogen for heating buildings concludes

79 A report from ICF and the American Gas Foundation found that RNG produced from food waste and dairy/swine manure feedstocks are likely to result in emissions reductions when netting out emissions reductions from the agricultural source, but landfill gas, beef/poultry manure, water resource recovery facilities, and other feedstocks have positive lifecycle emissions. AGF and ICF, [Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment](#) (December 2019), p. 72, Table 41.

80 AGA 2023 Playbook, "[Innovation.](#)"

81 Fuel Cell & Hydrogen Energy Association, [Road Map to a U.S. Hydrogen Economy](#) (2020), p. 32.

82 Tom DiChristopher, "[Gas utilities increasingly focus on pipeline blending in hydrogen pilot projects.](#)" S&P Global Market Intelligence (May 17, 2023).

83 Tom DiChristopher, "[Gas utilities get to work piloting hydrogen use in distribution systems.](#)" S&P Global Market Intelligence (March 10, 2022).

that “the scientific evidence does not support a major role for hydrogen in cost-optimal decarbonization pathways.”<sup>84</sup> Instead, electrification and district heating are preferable due to higher efficiency and lower costs. The essential reason is thermodynamics: “heating with hydrogen is significantly less efficient” compared to heat pumps and other alternatives.<sup>85</sup>

**In addition to efficiency and cost concerns, other considerations include:**<sup>86</sup>

- » **Safety:** Hydrogen is more hazardous than fossil gas—it is more susceptible to combustion, ignites at a lower temperature, and burns hotter and faster.
- » **Pipeline materials compatibility:** Hydrogen is known to have a degrading effect on materials and components used in gas infrastructure systems, such as pipes, fittings, valves, joints, and welds. A hydrogen embrittlement phenomenon has been observed in many metals.
- » **Impact on end-use appliances:** Appliances and furnaces are not certified to burn hydrogen. As the percentage of hydrogen blends increases, end-use appliances may require modifications, and attendant safety and failure risks may develop.
- » **Leakage rates:** Because it is a small molecule, leak rates from gas distribution pipes will increase with hydrogen blending. For polyethylene pipes—the most widely used plastic piping material in gas distribution systems—most hydrogen loss is expected to occur through pipe walls rather than through joints. In addition, since hydrogen has only one-third the energy content of methane, increased pipeline operating pressures will likely be needed to deliver the same amount of energy; higher pressures in turn will increase leak flow rates.
- » **Indirect greenhouse gas emissions and environmental impacts:** Hydrogen is an indirect potent greenhouse gas and air pollutant that, because of chemical reactions, increases the lifetime and amounts of methane, ozone, and water in the atmosphere.<sup>87</sup> In addition, since the vast majority of hydrogen today is made from fossil fuels, its production process contributes to global warming. Finally, while burning hydrogen does not give off carbon dioxide, it does create nitrogen oxides, which cause asthma.

A key takeaway is that hydrogen’s unique properties make it “significantly more dangerous compared to methane” when transported in existing fossil gas pipelines.<sup>88</sup>

There is broad agreement that hydrogen could be helpful for particular, hard-to-electrify industries, such as steelmaking, aviation, and transoceanic shipping. But it is still a fuel that can be either very dirty or very clean depending on how it is produced, transported, and stored.

<sup>84</sup> Jan Rosenow, “[A meta-review of 54 studies on hydrogen heating](#),” *Cell Reports Sustainability* (December 14, 2023).

<sup>85</sup> *Ibid.*

<sup>86</sup> On considerations regarding blending hydrogen into the existing gas infrastructure network, see: Miroslav Penchev et al., [Hydrogen Blending Impacts Study Final Report](#) (2022, CPUC); Richard B. Kuprewicz, Accufacts Inc., [Safety of Hydrogen Transportation by Gas Pipelines](#) (November 2022, prepared for the Pipeline Safety Trust); Massachusetts DPU, DPU 22-149, Statement of Robert W. Howarth, PhD, “[RNG & green hydrogen should not be used for heating](#)” (January 4, 2023); and Gas Transition Allies, [Facts on heating with hydrogen](#).

<sup>87</sup> Ocko and Hamburg find that hydrogen emissions could have about 30 times the warming power of carbon dioxide, pound for pound, over the first 20 years after being emitted (Figure 3). Ilissa B. Ocko and Steven P. Hamburg, “[Climate consequences of hydrogen emissions](#),” *Atmospheric Chemistry and Physics* (2022).

<sup>88</sup> Richard B. Kuprewicz, Accufacts Inc., [Safety of Hydrogen Transportation by Gas Pipelines](#) (November 2022, prepared for the Pipeline Safety Trust), p. 6.

**Considerations for the role of alternative fuels and technologies.** As the energy transition evolves, there may be limited, strategic uses for alternative fuels where electrification is not yet feasible or other solutions are still emerging. A prime guardrail for ensuring that these fuels do not work against decarbonization efforts is to use them only where they are produced. Keeping them out of pipelines and building heating systems will limit emissions and pollution.

Gas company plans to blend alternative fuels into the distribution system jeopardize the massive, urgent renewable energy buildout that is needed now. Fundamentally, these plans endanger the economic viability of a successful energy transition. Legislative, regulatory, and executive-level corrections must ensure that solar and wind are used directly for electrification rather than converted into costly, inefficient green hydrogen for piping and heating. Significant watchdogging and oversight are also needed to correct misinformation, financial incentives, and future-of-gas planning that permit misaligned investments in gas infrastructure. A safe, equitable, managed transition away from gas requires decommissioning the gas system while scaling investments in renewable electricity, weatherization, community-scale thermal systems, and other non-combusting, non-polluting solutions.

## Other developments

### Statewide future-of-gas investigations and exemplary rate case orders

Some states have begun to consider their options for the future of gas in light of state and municipal greenhouse gas reduction mandates and market pressures that are reducing the demand for gas. The formal parties to these investigations are typically investor-owned gas utilities and their regulators. Some of them have allowed participation by the state attorney general's office and environmental and consumer stakeholders. Most of the investigations have engaged energy modeling consultants to scope out possible scenarios and pathways. In some cases (for example, Massachusetts), the consultants were retained by the investor-owned utilities themselves, raising serious questions about the independence and integrity of the findings.

Formal future-of-gas planning and related proceedings have occurred or are underway in 12 jurisdictions that represent a wide range of climates, demographics, and economies: California, Colorado, District of Columbia, Illinois, Massachusetts, Minnesota, Nevada, New Jersey, New York, Oregon, Rhode Island, and Washington.<sup>89</sup> The main themes under consideration are:<sup>90</sup>

- » How to align utility planning with climate goals
- » How to equitably finance existing gas assets
- » How to halt the expansion of the gas system

<sup>89</sup> Illinois is due to formally announce a future of gas proceeding in February 2024. For a comprehensive recent listing and description of these proceedings, see Public Service Commission of Maryland, Petition of the Office of People's Counsel for Near-Term, Priority Actions and Comprehensive, Long-Term Planning for Maryland's Gas Companies, Appendix C—[Comprehensive Planning Proceedings in Other States](#) (February 9, 2023).

<sup>90</sup> Kristin George Bagdanov, "[The Future of Gas: A Summary of Regulatory Proceedings on the Methane Gas System](#)," DecarbNation Blog, BDC (December 15, 2022).

- » How to transition away from the gas system while maintaining safe, reliable, and affordable energy access
- » How to provide a just transition for gas workers

In late 2023, the Massachusetts Department of Public Utilities (DPU) issued a transformative and sweeping final ruling in the state’s future-of-gas proceeding.<sup>91</sup> It rejected the inclusion of RNG in the resource portfolios of gas utilities on the grounds of its negative cost, emissions, and availability implications. Instead, the DPU directed “LDCs to focus on targeted electrification and—pending the outcome of current pilots—networked geothermal projects to meet the long-term climate targets of the Commonwealth.”<sup>92</sup> Going forward, the examination of NPAs will be required. The DPU also found that “it will be impractical to maintain the gas distribution system solely for backup furnaces in cold weather.” Regarding downsizing the gas system, the DPU ordered that each LDC coordinate with the relevant electric company to propose at least one demonstration project for “decommissioning an area of its system through targeted electrification.”<sup>93</sup> Finally, the DPU directed LDCs to forecast “the potential magnitude of stranded investments” and identify the impacts of accelerated depreciation proposals and other alternatives.<sup>94</sup>

A development in Illinois in late 2023 is also worthy of mention. The state’s four largest investor-owned gas utilities received final rate case orders from the Illinois Commerce Commission (ICC) that cut revenue requirement requests by 25 to 51 percent and, for some, rejected substantial amounts of their requested gas infrastructure investments.<sup>95</sup> While each LDC secured significant rate hikes on net, taken together the orders have been described as a “regulatory earthquake.” This tightened oversight stands in sharp contrast to a decade of relatively permissive orders supporting gas system expansion.<sup>96</sup> The ICC also ordered that, beginning in 2025, the LDCs file biennial Long-Term Gas Infrastructure Plans with the Commission that, for the first time, would require gas utilities to publicly disclose their five-year investment action plans. Finally, the ICC stated that a statewide future-of-gas investigation would be announced in early 2024 and ordered the utilities to implement a tiered discount rate system for low-income gas customers by fall 2024, with the goal of ensuring that customers pay no more than 3 percent of their monthly income toward heating bills. Washington is the only other state mandating such a discounted rate structure.

### **Demonstrations exploring alternative or ancillary business models for gas utilities**

One of the topics raised in future-of-gas investigations is whether gas utilities can evolve by developing business models that rely on distributing non-combusting, renewable energy produced by thermal energy networks (see Figure 10). Such systems connect

91 MA DPU, [Order on Regulatory Principles and Framework](#), DPU 20-80-B (December 6, 2023).

92 Ibid, p. 81.

93 Ibid, p. 87.

94 Ibid, p. 101.

95 The largest pushback was for Peoples Gas & Light Co. which provides gas service for the City of Chicago. The ICC ordered a “pause” in People’s pipeline replacement program (\$265 million), pending the findings of a new investigation of the program to be conducted in 2024.

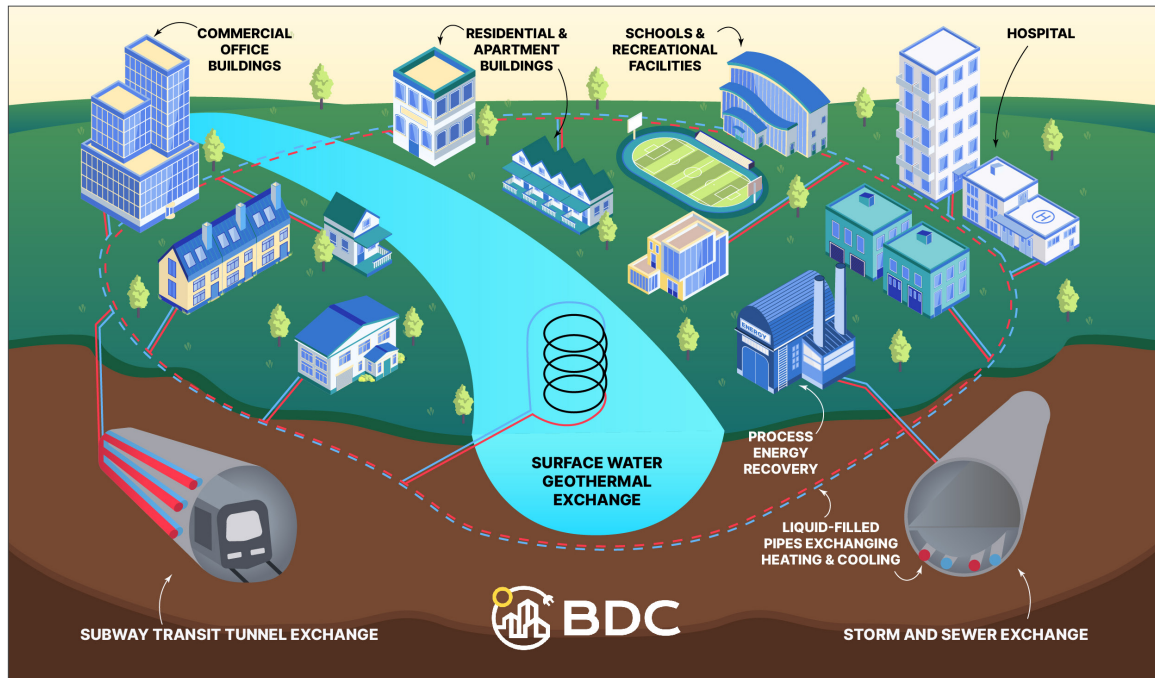
96 Andrew Adams, [“Advocates hail regulatory ‘earthquake’ as state slashes gas rate increases.”](#) Capitol News Illinois (November 17, 2023).



multiple buildings with different heating and cooling needs, using ambient-temperature loop systems to circulate non-combustible fluids through a network of pipes, and then add or remove heat in order to provide heating, cooling, and domestic hot water.<sup>97</sup>

### Figure 10: How TENs exchange inter-building heating and cooling loads

Thermal energy networks provide efficient and affordable clean energy heating and cooling to entire neighborhoods through a shared network of water pipes that transfer heat in and out of buildings by exchanging heat between a number of energy sources.



Source: [Building Decarbonization Coalition](#)

The shared inter-building loads can utilize geothermal boreholes,<sup>98</sup> waste heat, or surface water energy connected to heat exchangers. Thermal technologies are not new. They are used widely in Europe, Canada, and the United States on campuses, in communities, and for larger institutional facilities. These networks optimize the efficiency of shared thermal sources, offering utilities and municipalities the prospect of sources of revenue and related or complementary workforce deployment. Significantly for electrification, thermal energy networks also reduce peak electric loads, reducing the costs of electric supply and the buildout of electric grid infrastructure. See Table 4 for examples of thermal network projects currently sponsored by gas utilities.

<sup>97</sup> Vermont Community Thermal Networks, [Fact Sheet](#).

<sup>98</sup> HEET, [“Geothermal Networks: System Components & Benefits.”](#)

#### Table 4: Gas utility-sponsored thermal energy network projects underway

In **Massachusetts**, the first two networked geothermal installations by gas utilities in the country are underway under the auspices of Eversource and National Grid.<sup>99</sup> In one of these installations, the utility will replace all gas appliances with electric appliances, demonstrating how a gas utility can enable electrification. Massachusetts has already passed a law allowing gas utilities to access accelerated cost recovery for these projects under the same program that allows utilities accelerated cost recovery for replacing gas pipelines.

**Boston** announced a significant new thermal energy utility project in January 2024: a networked geothermal system to provide heat and cooling to over 300 low- and moderate-income families, including elderly and individuals with disabilities, living in one of the Boston Housing Authority's oldest communities, Franklin Field.<sup>100</sup> Built in the early 1950s, Franklin Field is home to a mix of African-American and Caribbean families.

In **New York**, the Public Service Commission has initiated a proceeding to implement the Utility Thermal Energy Network and Jobs Act of 2022. The Act authorizes the state's utilities to own and operate thermal energy networks and calls for the Commission to require the seven largest investor-owned utilities to submit at least one and up to five proposed thermal network pilot projects for review, with at least one pilot project located in a disadvantaged community within each utility service territory. In December 2023, New York utilities submitted plans for 13 thermal projects with locations spanning "dense midtown Manhattan commercial centers to low-income housing, and from neighborhoods in the Hudson Valley to the upstate town of Ithaca, N.Y."<sup>101</sup>

In **Philadelphia**, a Business Diversification Study for Philadelphia Gas Works (PGW) selected large-scale adoption of networked geothermal as one of four decarbonization options for the City to consider. In these systems, water-filled loops would be used to both heat and cool an entire street or neighborhood. In August 2022, the City approved a feasibility study for networked geothermal as part of PGW's FY 2023 operating budget.<sup>102</sup>

**Colorado** in 2023 adopted an expanded definition of a clean heat resource that includes thermal energy systems and the Public Utilities Commission is required to develop rules for thermal energy. The Act also authorizes gas utilities serving more than 500,000 customers to propose pilot thermal energy network projects.<sup>103</sup>

In **Minnesota**, the Natural Gas Innovation Act of 2021-2022 permits gas companies to sell electric heating technologies such as air-source heat pumps and geothermal or aquifer thermal applications. In addition, it encourages gas utilities to file "innovation plans" to decarbonize their operations. These pilots are eligible for rate recovery and may include biogas, RNG, hydrogen, ammonia, carbon capture, strategic electrification, district energy, and energy efficiency.<sup>104</sup>

#### Sale of gas utility distribution systems

*The Wall Street Journal* reported in April 2023 that Dominion Energy and National Grid—two of the largest gas utilities in the U.S.—were weighing potential sales of parts of their U.S. natural gas pipeline networks.<sup>105</sup> So far, these sales have not occurred. In May 2022, however, National Grid sold its gas and electric operations in Rhode Island to an energy company based in Pennsylvania, PPL Corp.<sup>106</sup>

99 See HEET, "[What Is Gas to Geo?](#)" and Miriam Wasser, "[The country's first gas utility-run networked geothermal heating and cooling system breaks ground in Mass.](#)" WBUR (June 13, 2023).

100 Phil Tenser, "[Little confirmed yet about plans to harvest geothermal energy for Boston homes.](#)" WCVB (January 10, 2024).

101 Jeff St. John, "[New York will replace gas pipelines to pump clean heat into buildings.](#)" Canary Media (January 16, 2024). The regulatory docket for these thermal energy products can be found [here](#).

102 Energy & Environmental Economics et al., [Philadelphia Gas Works Business Diversification Study](#) (December 2021).

103 Colorado General Assembly, [HB23-1252 Thermal Energy](#), 2023 Regular Session.

104 Frank Jossi, "[Under new law, Minnesota gas utilities could play a role in electrification.](#)" Energy News Network (July 21, 2021).

105 Dominion reportedly is considering selling its gas distribution companies serving North Carolina, Ohio and parts of the western U.S., which could be worth as much as \$13 billion. National Grid is exploring a possible sale of part of its pipeline network serving the northeast. Katherine Blunt et al., "[Utilities Pursue Pipeline Sales as Natural-Gas Bans Catch On.](#)" *The Wall Street Journal* (April 6, 2023).

106 National Grid continues to own a liquefied natural gas facility in Providence. National Grid, "[National Grid U.S.A. Completes Sale of The Narragansett Electric Company to PPL Rhode Island Holdings, LLC.](#)"



## IV. Immediate Methane Abatement Measures

With climate catastrophe now a clear and present danger, remedies with immediate impact have new urgency. Coordinated civic, governmental, regulatory, and industry action is needed to reduce methane emissions rapidly and effectively. A number of proven, important measures can be prioritized for the near-term. While abatement measures are by definition more circumscribed or temporary than systems-level transformation (see Section V), these emissions reduction strategies yield significant mitigation and real-time results. Recent peer-reviewed research demonstrates the critical role that emissions mitigation measures can play in slowing global warming<sup>107</sup> while also creating important benefits to health, public safety, and the environment.

### Immediate measures can be grouped in three broad categories:

- » Locating and eliminating methane leaks
- » Adopting state methane reduction programs for gas utilities or emission taxes and fees
- » Reducing gas end use and demand via local and state policies and regulations

### A. Locating and eliminating leaks

Investing greater resources in locating and eliminating leaks in the gas distribution system (and the entire gas system) is one of the most straightforward, cost-effective measures to immediately reduce methane emissions. Technologies and protocols for detecting and repairing leaks have improved considerably over the last decade, but their adoption has lagged, as gas utilities do not pay for the leaked gas and, therefore, have little incentive to invest in repairs.

This section provides background on where responsibility lies for detecting and repairing leaks, describes economic principles that help to explain gas utility practices, and then reviews an important new development—recently proposed PHMSA regulations regarding leak detection and repair that would significantly strengthen gas operator responsibility for surveying and remediating leaks.

#### Background

Federal law 49 CFR 192.723 requires gas utilities to conduct periodic leakage surveys using “leak detector equipment” to identify leaks that could be hazardous to public safety or property.<sup>108</sup> PHMSA specifies the minimum frequency of these surveys as follows:

<sup>107</sup> Ilissa Ocko et al., “[Acting rapidly to deploy readily available methane mitigation measures by sector can immediately slow global warming.](#)” *Environmental Research Letters* (2021).

<sup>108</sup> In addition, the EPA coordinates a [Methane Challenge Program](#), which seeks voluntary commitments from oil and gas companies to mitigate methane leaks. Approximately 60 companies participate and accomplishments are self-reported.

- » Business districts (areas containing shops and offices) must be surveyed at intervals “not exceeding 15 months, but at least once each calendar year,” and
- » Areas outside business districts must be surveyed “at least once every 5 calendar years at intervals not exceeding 63 months.”<sup>109</sup>

Utility leak surveys test all available openings in gas, electric, telephone, water, and sewer manholes. Hazardous leaks must be reported to PHMSA and promptly repaired, although specific timeframes are not required. PHMSA regulations leave the repair of non-hazardous leaks to the discretion of each gas utility. Most states have adopted even more stringent safety regulations, often in response to gas incidents, public pressure, and changing public priorities, such as the need to reduce greenhouse gases.

### Economics of methane leaks

Economic theory suggests that, in the absence of any price regulation, companies will identify and eliminate gas leaks if the economic cost of these activities is less than the value of the lost gas.<sup>110</sup> However, in most states, gas utilities have regulatory approval to pass on the cost of lost gas directly to their retail rates (i.e., to their customers) as a “normal” cost of business, thus eliminating any financial incentive to locate and repair leaks.<sup>111</sup>

Research demonstrates that gas utilities do not locate or repair leaks at levels that would be best for society as a whole, given all external and internal costs and benefits. One survey of U.S. gas utilities from 1995 to 2013 found that leak detection and abatement activities resulted in costs far below the saved commodity value of gas, avoided climate change damages, and safety benefits.<sup>112</sup> In other words, utilities “do not fully take advantage of cost-effective leak mitigation opportunities.”<sup>113</sup>

In addition, pipeline replacement programs have actual costs that far exceed the net present value of the replacement activity. Levelized costs are often well above both leak detection and repair costs and the combination of gas costs and climate benefits. However, pipeline upgrades may pass a cost-benefit test when they occur in very densely populated areas and when safety benefits are accounted for. This over-investment in replacement reflects an additional distortion: utilities are allowed to earn a rate of return on capital investments, but not on leak detection and repair, which is made up of labor and other variable costs.<sup>114</sup>

109 For cathodically unprotected distribution lines on which electrical surveys for corrosion are impractical, a leakage survey must be conducted at least once every 3 calendar years at intervals not exceeding 39 months.

110 The value of lost gas is essentially just its commodity price—currently about \$13.80 per Mcf.

111 This paragraph draws heavily on Catherine Hausman and Daniel Raimi, [Plugging the Leaks: Why Existing Financial Incentives Aren't Enough To Reduce Methane](#), Kleinman Center for Energy Policy, University of Pennsylvania (January 2019).

112 Catherine Hausman and Lucija Muehlenbachs, “[Price Regulation and Environmental Externalities: Evidence from Methane Leaks](#),” *Journal of the Association of Environmental & Resource Economists* (2018). The researchers report realized leak detection and repair costs of \$0.48/Mcf; a commodity value of gas then averaging \$4.25/Mcf; benefits valued at \$27/Mcf before safety benefits; and pipeline replacement expenditures that range from \$48/Mcf to \$211/Mcf. The researchers also find that the estimated safety benefits from both leak detection and replacement of vintage pipe are small compared to the greenhouse gas benefits.

113 *Ibid.*, p. 75.

114 In the economics literature, this is called the Averch-Johnson effect which holds that “utilities overinvest in capital when the regulated rate of return is higher than the cost of capital.” *Ibid.*, p. 100.

Gas companies do not face sufficient incentive “to avoid the leakage of their primary input” not only because they pass on the value of the lost gas to consumers, but also because they do not have to price in any of the social costs associated with gas (see Section II.C for more on social costs). While fossil gas imposes outsized social costs, gas utilities are not held responsible for the climate and other costs caused by the leakage of their own product and infrastructure.<sup>115</sup>

### Proposed revised federal regulations on leak detection and repair (LDAR)

On May 18, 2023, PHMSA published a notice of proposed rulemaking (NPRM) intended to improve the detection and repair of leaks from new and existing gas pipelines (transmission, distribution, and gathering) and certain gas facilities (underground storage and LNG facilities).<sup>116</sup> In its Preliminary Regulatory Impact Analysis, PHMSA underscores that, “The Federal leak detection and repair standards for gas pipelines have remained largely unchanged since the 1970s despite significant improvements in leak detection technology and operator practices and the increasingly urgent and tangible threats from climate change.”<sup>117</sup>

PHMSA finds that “operators currently allow leaks from gas pipelines to continue emitting methane and other gases for extended periods of time, thereby threatening the environment as well as public safety and human health.”<sup>118</sup> Its analysis underscores two critical underlying factors: a) the full societal and global cost of emissions of methane and other gases associated with leaks from gas pipeline facilities are borne not by pipeline operators responsible for detecting and repairing leaks, but rather by society as a whole, and b) market forces alone have proven insufficient to fully incentivize gas utilities to detect and repair leaks.<sup>119</sup>

The proposed regulations attempt to address the problem that “[existing federal] provisions lack sufficiently robust and enforceable standards for the performance of leakage surveys and repair of leaks discovered, especially for leaks that pipeline operators consider ‘non-hazardous’ to safety based on the leak rate, location, and other factors.”<sup>120</sup> The new PHMSA rules would require public utility commissions to set and enforce performance standards for gas utilities in four areas:

- 1. New and increased leakage survey and patrolling requirements.** Leakage surveys would be conducted using leak detection equipment in accordance with proposed new advanced leak detection program (ALDP) requirements as well as new leak grading and repair requirements.

<sup>115</sup> Ibid., pp. 74-75.

<sup>116</sup> Federal Register, Pipeline Safety: [Gas Pipeline Leak Detection and Repair, A Proposed Rule by PHMSA](#) (May 18, 2023). The proposed rule was issued in response to Section 113 of the [PIPES Act of 2020](#), which directed PHMSA to reduce methane leaks as part of its traditional role as a pipeline safety regulator and as an environmental protection measure.

<sup>117</sup> PHMSA, Preliminary Regulatory Impact Analysis, [Pipeline Safety: Gas Leak Detection and Repair Proposed Rule](#) (April 2023), p. 116.

<sup>118</sup> Federal Register, Pipeline Safety: [Gas Pipeline Leak Detection and Repair, A Proposed Rule by PHMSA](#) (May 18, 2023).

<sup>119</sup> PHMSA, Preliminary Regulatory Impact Analysis, [Pipeline Safety: Gas Leak Detection and Repair Proposed Rule](#) (April 2023), p. 9.

<sup>120</sup> PHMSA, Preliminary Regulatory Impact Analysis, [Pipeline Safety: Gas Leak Detection and Repair Proposed Rule](#) (April 2023), p. 9.

2. **Advanced leak detection programs.** (Proposed new §192.763). Gas distribution operators would be required to implement written ALDPs and establish performance standards for the sensitivity of leak detection equipment and the effectiveness of their ALDPs.
3. **Leak grading and repair requirements.** (Proposed new §192.760 and revised §192.3). Gas distribution operators would be required to develop written procedures to implement proposed new and enhanced requirements for grading and repairing any leak detected on any pipeline components. Leak repair requirements would no longer apply only to leaks identified as potentially explosive.
4. **Reporting and the National Pipeline Mapping System.** The NPRM proposes new and revised reporting requirements for large-volume gas releases, the number of leaks detected and repaired by grade, the number of unrepaired leaks by grade, and the estimated aggregate emissions from leaks by grade.

#### Gas utilities would be required to:

- » **Conduct more frequent leak surveys.** Non-business districts with non-cathodically protected or other leak-prone pipeline must be surveyed at least once a year as opposed to every three years, with intervals not to exceed 15 months as opposed to 39 months.<sup>121</sup> Surveys must use advanced leak detection equipment that meets a specified set of performance standards. Surveys of business districts would remain at once per calendar year (with intervals not to exceed 15 months).
- » **Expand the definition of hazardous leaks.** New rules would extend the classification of Grade 1 leaks beyond leaks that are hazardous to people and property to include leaks that present an existing or probable “grave hazard to the environment.” Similarly, the definition of Grade 2 leaks would include leaks that present “significant” hazards to the environment (defined as leaks with a leakage rate of 10 cubic feet per hour),<sup>122</sup> requiring gas operators to prioritize the repair of environmentally significant leaks.
- » **Accelerate repairs.** The timing of new Grade 2 leak repairs would shorten to within six months. Leaks subject to this timeline must be re-evaluated every 30 days until repaired to ensure that they do not degrade into Grade 1 leaks. Grade 2 leaks existing before the effective date of the new rule must be repaired within one year. New Grade 3 leaks must be repaired within two years (and if located on leak-prone pipe, replacement must be conducted within five years), existing Grade 3 leaks within three years. All Grade 3 leaks must be re-evaluated once every six months. For Grade 3 leaks occurring on pipelines scheduled for replacement or abandonment, those sections must be replaced within five years.

<sup>121</sup> See Table 1 in the [Preliminary Regulatory Impact Analysis](#) for a summary of the principal changes proposed for each segment of the gas system (pp. 12-15).

<sup>122</sup> This provision is intended to require gas operators to prioritize the repair of significant environmental leaks, backed by research showing that “methane leaks larger than 10 CFH represented only 2% of all leaks by number but over half of all emission volumes...” Federal Register, [Pipeline Safety: Gas Pipeline Leak Detection and Repair, A Proposed Rule by the Pipeline and Hazardous Safety Administration](#) (May 18, 2023), p. 194.

- » **Conduct enhanced leak monitoring.** New rules require special leak surveys after environmental or weather-related changes (such as freezing ground or heavy rain) and extreme weather events. All leak repairs must also be evaluated and documented 30 days later to ensure successful repair.

Taken together, PHMSA's Preliminary Regulatory Analysis and Draft Environmental Assessment constitute a definitive, impactful presentation of the problem of gas leaks and their treatment by gas utilities. The proposed rules would significantly strengthen existing federal regulations, for the first time recognizing distribution leaks as an environmental problem and requiring operators to find and fix more leaks. In particular, they would require far greater attention to identifying leaks and repairing those with an outsized environmental impact.<sup>123</sup>

PHMSA received over 25,000 public comments from the general public, gas companies, gas trade associations, environmental stakeholders, Congressional leaders, and companies providing services or technology to the gas industry. In general, gas companies and their trade associations argued that: PHMSA was overstepping its legal mandate; accelerated leak repair would divert resources and attention away from pipeline replacement and infrastructure modernization; and current regulations are sufficient for satisfactory leak and methane emission mitigation.<sup>124</sup>

Environmental stakeholders pressed for two additional rules: requiring residential methane detectors and mandating that operators report on hydrogen blending before it occurs in order to address safety and environmental concerns as well as notify regulators and the public. Additionally, consideration should be given to whether technologies to *renew* pipeline via flexible liners, inserts, and cured-in-place systems (thereby extending pipeline life for multiple decades) should be treated as pipeline “replacement” as opposed to “repair.” As noted in a 2017 report by the U.S. Department of Energy, “These technologies can be a lower-cost leak reduction option than pipeline replacement in some cases, especially for pipe that is expensive to replace because it is large or deeply buried. However, some regulators, notably PHMSA, do not recognize pipe lining as an alternative to replacement. Thus, lined cast iron pipe is considered the same as unlined pipe for reporting purposes, which limits the incentive for developing or implementing potentially effective and cost-effective alternative technologies.”<sup>125</sup>

### Adopting enhanced leak detection and monitoring

Two legacy methods have dominated downstream leak detection: customer calls and walking surveys using handheld gas sensors. Periodic walking surveys by inspectors form the basis of most regulation, but companies also may rely heavily on odor calls from customers. The smelly chemical mercaptan is added to gas, which otherwise has

<sup>123</sup> In addition to the new proposed PHMSA rule, the EPA in December 2023 [finalized an important new rule](#) to reduce methane and other pollution from upstream and midstream oil and gas operations including well sites, compressor stations, processing facilities, and transmission and storage facilities.

<sup>124</sup> The gas associations request that the exemption for Grade 3 leak repairs scheduled for replacement be revised from 5 to 10 years and that a similar provision be available for Grade 2 leaks scheduled for replacement within five years. AGA, et al., [Comments on Pipeline Safety: Gas Pipeline Leak Detection and Repair](#) (August 16, 2023), p. 67.

<sup>125</sup> DOE, Office of Energy Policy and Systems Analysis, [Natural Gas Infrastructure Modernization Programs at Local Distribution Companies: Key Issues and Considerations](#) (January 2017), p. 18.

no smell, so people can detect leaks. While most people are accustomed to smelling gas, particularly in dense urban areas, customer calls are unreliable; however, some gas utilities rely heavily on these reports. For example, in Massachusetts, from 2018 to 2020, the state's six investor-owned utilities identified 58 percent of their non-excavation leaks via public odor calls. National Grid, the largest gas utility in the state, indicated that over 72 percent of its leaks in its Boston territory were identified by customer odor calls.<sup>126</sup>

Over the last decade, leak detection strategies and methods have evolved rapidly, resulting in commercial availability of more advanced leak detection technologies, such as cavity ring-down spectroscopy (CRDS).<sup>127</sup> In addition, important advancements in mobile deployment platforms using passenger vehicles or backpacks, as well as survey protocols and analytics, make leak detection more accurate and more cost-effective. For example, CRDS technology can be installed on Google Street View vehicles with GPS to track location, and sensors to track environmental conditions such as wind speed and direction. Data can also be aggregated to develop emissions heatmaps and estimates of emissions by pipeline segment to then optimize pipeline replacement. Experts in the field often combine multiple technologies—for example, mobile detection surveys followed by walking surveys using handheld devices—in order to zero in on leaks identified by the mobile surveys or to assess survey coverage gaps.

In general, leak detection surveys using advanced technologies find a significantly higher incidence of leaks and greater overall leak volume compared to traditional walking surveys and gas odor calls. One study showed that utility crews located only 35 percent of the leaks identified by independent researchers using advanced leak detection.<sup>128</sup> Applying this detection rate at the national scale, the total inventory for gas distribution leaks would increase by a factor of 2.4.

In addition, leak quantification methodologies and associated analytics have evolved considerably. They now allow pipeline replacements and leak repairs to be prioritized based on leak flow-rate data and can take safety factors into account. This allows repair decisions to maximize emissions reduction and cost effectiveness.

Research is also yielding improved methods for pipeline monitoring and inspection. The interior of pipes can be inspected with trenchless methods of intelligent “pigging” and robotic pipe inspection using “crawlers” to search for rust, weak seams, thinning walls, and other indicators that a pipe needs repair or replacement. While these non-destructive evaluation methods have been developed to inspect steel pipelines, a solution for plastic pipes is in early stages.

Despite these advances, the continued infrequency of leak surveys and slow adoption of new technologies mean that gas utilities are not making needed progress on leak identification and repair. Although federal regulations specify the minimum frequency of leakage surveys, an overview of leak detection methods reports that “One of the

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126 Calculations by author based on [National Grid 21-GSEP-03](#).

127 Highwood Emissions Management, [Technical Report: Leak detection methods for methane gas gathering, transmission, and distribution pipelines](#) (2022).

128 Zachary Weller et al., [“Vehicle Based Methane Surveys for Finding Natural Gas Leaks and Estimating their Size: Validation and Uncertainty,”](#) *Environmental Science and Technology* (2018).

drawbacks of the existing system in place for distribution pipeline leak surveys is the infrequency of the campaigns. Most utilities conduct system-wide surveys every 3-5 years, allowing for high persistence of small leaks that are not otherwise detected.”<sup>129</sup>

Furthermore, while current PHMSA regulations permit reliance on smell or visual surveys—leak detection methods that are better suited for identifying ruptures or accumulated gas than smaller leaks—these methods have shortcomings for detecting small or large leaks that are unlikely to cause explosions that could harm people and property. As a result, according to PHMSA, the existing “regulatory regime allow[s] operators to rely on inadequate or ineffective leak detection equipment and practices, rather than encouraging use of commercially available, advanced leak detection technologies and practices.”<sup>130</sup> The new PHMSA rulemaking on LDAR aims to set better standards to correct the fact that “regulatory requirements lag commercially available, advanced leak detection technologies.”<sup>131</sup>

### Prioritizing super-emitter leaks

Research studies have shown that methane emissions from distribution systems are driven by a small set of larger leaks that emit substantial amounts of methane into the ground and atmosphere.<sup>132</sup> These large leaks can cause significant environmental harm. Currently, gas utilities are under no federal obligation to identify and fix super-emitters, so directing gas utilities to target these leaks for accelerated repair is likely to yield significant emissions reduction benefits. Four examples of super-emitter programs (two statewide, two utility-based) are described in Table 5.

Table 5: Examples of super-emitter programs
<p><b>Massachusetts:</b> The Massachusetts Significant Environmental Impact (SEI) Program took effect in March 2019 implementing regulations mandated by The Act to Promote Energy Diversity of 2016. Gas utilities are required to identify Grade 3 significant environmental impact (SEI) leaks and repair them within two years, with the incentive that the cost of these repairs can be recovered on an accelerated basis via the utilities’ Gas System Enhancement Plans (GSEP), which are used for accelerated pipeline replacement cost recovery. If the SEI leak is located on a segment of pipe slated for replacement under the utility’s GSEP, then the utility has up to five years to address the leak. The nonprofit HEET spearheaded the SEI initiative, collaborating with researchers and gas utility leaders to develop a Shared Action Plan. HEET continues to provide independent guidance and verification.</p>

129 Highwood Emissions Management, [Technical Report: Leak detection methods for methane gas gathering, transmission, and distribution pipelines](#) (2022), p. 30. Some states have accelerated the frequency of their leak detection surveys. Massachusetts, for example, surveys non-business districts once every 24 months instead of every five years. Schools, churches, hospitals, theaters, and arenas are to be surveyed at least once annually. In California, PG&E moved to a three-year leak survey cycle on January 1, 2018.

130 Federal Register, [Pipeline Safety: Gas Pipeline Leak Detection and Repair, A Proposed Rule by the Pipeline and Hazardous Safety Administration](#) (May 18, 2023), p. 31913.

131 Ibid.

132 Hendrick et al. (2016) surveyed 100 gas leaks in cast iron distribution mains in Metro Boston. Just seven leaks (7%) contributed 50% of measured fugitive methane emissions. A.R. Brandt et al. (2016) analyzed data from 18 prior studies and found that the top 5% of emitters accounted for more than 50% of emissions. Using a national sampling program, Lamb et al. (2015) surveyed methane emissions from 13 urban distribution systems. Only 2% of leaks were greater than 10 scfh, and these large leaks accounted for 56% of total methane emissions. A.R. Brandt et al., “[Methane leaks from natural gas systems follow extreme distributions](#),” *Environmental Science & Technology* (2016); B.K. Lamb et al., “[Direct Measurements Show Decreasing Methane Emissions from Natural Gas Local Distribution Systems in the United States](#),” *Environmental Science & Technology* (2015); M.F. Hendrick et al., “[Fugitive Methane Emissions from Leak-Prone Natural Gas Distribution Infrastructure in Urban Environments](#),” *Environmental Pollution* (2016).



**California:** Pacific Gas & Electric in California launched its own Super-Emitter Leak Survey & Repair Program in 2018. Both the California Air Resource Board's Oil and Gas Regulation and the CA Public Utility Commission's Gas Leak Abatement rulemaking require that PG&E conduct methane leak surveys and repairs throughout PG&E's gas transmission and distribution operations. PG&E introduced Picarro's mobile detection system for its compliance surveys in 2014. Leveraging that approach, in 2018, PG&E launched its own Super Emitter Program with the goal of rapidly identifying and repairing leaks larger than 10 standard cubic feet per hour (scfh). Partnering with the company Picarro, PG&E deployed a fleet of vehicles with advanced methane sensors to map its distribution system. As of 2021, PG&E identified and repaired over 700 super-emitter leaks in its distribution service and reports saving 0.67 billion cubic feet of gas. The cost effectiveness of this program is estimated at \$22/Mcf (one thousand cubic feet). PG&E owns and operates 42,800 miles of distribution pipeline in California with approximately 4.3 million gas customers.

**New York:** A 2021 rate case settlement for upstate New York National Grid requires the company to establish a high emitter methane detection program, targeting distribution system leaks of 10 cubic feet per hour or greater for repair or replacement. In late 2021, vendors were selected to conduct advanced leak detection work. National Grid is conducting follow-up investigations.<sup>133</sup>

**Connecticut:** In 2020, the Public Utilities Regulatory Authority adopted an enhanced gas leak classification system, based on the Massachusetts system, which provides for the identification of Environmentally Significant Grade 3 Leaks and their expedited repair within a timeframe ranging from 12-24 months depending on their size.<sup>134</sup>

### Combining advanced leak repair with selective vintage pipeline replacement

Advancements in pipe repair can now help avoid intensive pipe replacement for certain types of pipe and pressure settings, often with significant cost savings compared to pipeline replacement. These new technologies—many of them trenchless—can help to control methane leaks and significantly extend the life of a leaking or leak-prone pipe. The main technologies available are described below. Each offers important advantages over traditional pipeline replacement, but there are also limitations and disadvantages that require careful assessment.

#### Examples of pipeline repair technologies:

- » **Sleeving.** The interior of some cast iron and unprotected steel distribution pipes can be sleeved or lined with a flexible plastic insert fitted tightly within the pipe needing repair. According to the EPA, “reported methane emission reductions of 225 Mcf per year were associated with retrofitting one mile of cast iron main and one mile of unprotected steel services lines.” In addition, according to the EPA, “installing flexible liners offers an immediate payback when compared to the costs of excavation and installation of protected steel or plastic pipe.” The EPA estimates the cost of installing liners at \$10,000 per liner (in 2011) and concludes that “Flexible liners typically yield long-term solutions to leakage problems if properly installed.”<sup>135</sup>
- » **Robots.** In some cases, robotic tools can be used to line the inside of pipes typically 15 inches or more in diameter. Some leaking joints can be repaired using cast-iron sealing robots (CISBOTs) that inject the joints with an anaerobic sealant,

<sup>133</sup> National Grid, [Enhanced High Emitter Methane Detection Program Report](#) (download PDF) (April 2023).

<sup>134</sup> CT PURA, PURA Investigation into a Uniform Natural Gas Leak Classification, [Decision](#) (October 7, 2020), pp. 8, 10.

<sup>135</sup> EPA, [Insert Gas Main Flexible Liners, PRO Fact Sheet No. 402](#) (2011), p. 2/2.



efficiently reducing the potential for future gas leaks. The interior of pipes can be inspected with trenchless methods of intelligent “pigging” and robotic pipe inspection using “crawlers” to search for rust, weak seams, thinning walls, and other indicators that a pipe needs repair or replacement.<sup>136</sup>

- » **Keyholing tools.** Instead of larger open-cut excavation, keyholing tools can be used to create a small opening in a street or sidewalk to perform pipeline maintenance activities such as cast-iron joint leak repair and cathodic protection.
- » **Cured-in-place (CIP) pipeline renewal systems.** CIP systems can line cast iron and steel pipelines from 4” to 48” in diameter, creating a durable and impermeable composite pipe that is bonded as an inner liner to the host pipe without trenching.<sup>137</sup> Extensive testing by NYSEARCH/PHMSA and Cornell University has established that CIP lining can extend the life of cast iron pipes by up to 100 years of simulated aging.<sup>138</sup>

Examples of state policies in the United States that promote advanced leak repair are few and far between, as noted above. Massachusetts recently enacted policies to encourage advanced leak repair, broadening the expenditure of the GSEP cost recovery mechanism to include advanced leak repair that extends the life of the pipe for at least ten years. So far, however, only two of the six eligible investor-owned utilities (National Grid and Eversource) have indicated plans to take advantage of this incentive, totaling a modest \$16 million in 2023.<sup>139</sup> National Grid intends to apply the incentive only to pipelines not slated for replacement, deviating from the measure’s intention to substitute advanced repair for expensive vintage pipeline replacement when appropriate. National Grid argues that advanced leak repair, including CISBOT, is not a substitute for replacing pipe and that these repairs will not reduce the company’s inventory of leak-prone pipe. In contrast, Eversource states that it will use CISBOT to repair, rather than replace, some leak-prone mains through its GSEP since the identified repair method of utilizing a sealant with a 50-year effective life provides the same benefits of infrastructure replacement. In addition, this method is more cost effective since the leak-prone infrastructure is located in densely populated urban environments with congestion of underground utilities and structures.

The use of state-of-the-art repair technologies is hindered by the fact that the regulatory cost recovery system typically rewards replacement rather than repair. Pipe replacement is at the core of the profitability of the current investor-owned gas utility business model because utilities earn a rate of return on capital investment, such as replacing infrastructure, but not on repair activities, which are treated as operational expenses involving labor and other variable costs. In addition, since utilities typically pass on the cost of lost gas to their customers, they have no direct financial incentive to control or eliminate gas leaks. In other words, leaked gas is treated as a normal cost of doing business.

136 Tabitha Mishra, “[Understanding the Differences Between Pigging and Robotic Pipe Inspection Methods](#),” Trenchlesspedia (April 18, 2019).

137 Concerns have been raised about occupational and bystander safety and environmental pollution risks of CIP systems. See [CDC NIOSH](#) and [Wikipedia](#).

138 David W. Merte, “[Cured-in-Place Liner Research Demonstrates Long-Term Viability](#),” Underground Infrastructure Magazine (February 2016, 71:2); NYSEARCH, “[Cured In Place Liner \(CIPL\) Durability and Longevity Testing](#).”

139 The authorizing legislation is The Act Driving Clean Energy and Offshore Wind of 2022. MA DPU, CY2023 GSEP filings for National Grid, Docket No. 22-GSEP-03, [Exhibit NG-AS/MT-1](#), pdf pp. 22-25, and NSTAR (dba Eversource Energy), Docket No. 22-GSEP-06, [Exhibit ES-RJB-1](#), pdf pp. 23-24.

Gas utilities have traditionally taken the position that replacing mains and services is more efficient and cost effective than repairing leaks. However, the cost of pipe replacement exceeds that of leak repair by orders of magnitude, and leak repair technology has now evolved to the point where, for certain pipe materials, it competes with pipeline replacement for longevity. National Grid's Boston Division reports average leak repair costs for leak-prone mains of \$4,742 per leak in 2021 compared to \$3.4 million to replace a mile of main in 2023.<sup>140</sup> For illustration, if we assume that a mile-long section of distribution pipeline has four leaks (i.e., a leak rate of 4 leaks/mile), then repairing the leaks would cost \$18,968, an expense to be covered by the utility's annual operations and maintenance budget. Alternatively, replacing the entire mile would cost roughly 180 times more (\$3.4 million), and that cost would be passed on to ratepayers over approximately six decades, earning a rate of return for the utility (currently 8.9 percent for National Grid in Massachusetts).<sup>141</sup>

### Ensuring leak repair effectiveness

While repairing gas leaks is an important, cost-effective policy lever for reducing methane emissions from gas distribution systems, the effectiveness of these repairs is an outstanding question that needs to be understood and overseen. A recent study of leak repair in Massachusetts by Edwards et al. finds that gas utility leak repair operations and monitoring are seriously lacking, and that more effective leak repair and monitoring policies are needed. The study finds a 20 percent failure rate in leak repair statewide over the period 2014 to 2017, with the largest number of failures concentrated in the Boston metropolitan area and other large cities, such as Worcester, Springfield, and Lowell. In addition, the study conducted on-site gas leak measurements at 61 locations where repairs have been performed on potentially high-emitting Grade 3 leaks from 2019 to 2020 and found a failure rate of 75 percent. The study identifies several potential causes for repeat repair failures: "Utility workers may apply temporary fixes without eliminating the underlying leak. Leaks may also re-emerge along leak-prone segments of the network, or repairs may only address one of many leaks in the same vicinity." While gas utilities may suggest that replacement is a more effective strategy, the researchers instead urge greater policy and regulatory focus on the problem of repair failures, including creating incentives to successfully repair leaks (especially those that are high-emitting but nonhazardous) and developing clear protocols to verify and monitor repairs.

## B. Instituting methane emission taxes and fees, state methane reduction programs, and electrification subsidy programs

Methane leaks from the gas distribution system are largely unregulated, even though the lost commodity has value and creates sizable negative externalities for society and the environment. Utility companies make decisions based on the direct cost of and profit opportunity from their gas distribution investments, unencumbered by social costs to those harmed by the emissions and pollution.

140 MA DPU, Docket No. 23-GSEP-03, Exhibit NG-GPP-9, [Worksheet LPP Calc download](#).

141 MA DPU, Docket No. 23-GREC-03, Ex NG-MS-CSS-4, [Sched WACC download](#).

The standard solution to this kind of market failure is a policy intervention. Approaches include a tax or fee on emissions, programs that set performance standards for emission reductions and abatement, or subsidies for production and/or consumption activities that offset the externality (in this case, subsidies that incentivize the purchase and installation of cleaner space and water heating appliances).

### Methane emissions taxes and fees

Various forms of greenhouse gas emissions taxes have been introduced in the U.S. Congress for nearly twenty years. With the Inflation Reduction Act of 2022, the first-ever methane emissions tax was approved and will be applied to the upstream and midstream parts of the gas supply chain beginning in 2024; the downstream part of the gas system is exempted.<sup>142</sup> Beginning in 2024, gas production, processing, transmission, and storage facilities and related pipelines will face a charge starting at \$900 per metric ton of methane, increasing to \$1,500 after two years (these charges equate to \$36 and \$60 per metric ton of carbon dioxide equivalent). The tax will be imposed when reported emissions surpass thresholds that generally allow about 35 percent of emissions to occur “tax-free.”

Burlington, Vermont, recently established a carbon-related tax to help achieve the city’s goal of decarbonizing all buildings and achieving net-zero by 2030. The 2023 Carbon Fee Measure required voters to approve a charter change, which then had to be approved by the Vermont Legislature. A carbon pollution impact fee of \$150 per ton will be imposed on new construction buildings that install fossil fuel thermal energy systems. The same fee will be imposed on existing commercial and industrial buildings 50,000 square feet and larger if fossil fuel space conditioning or domestic water heating systems are installed instead of renewable systems.<sup>143</sup>

### Methane reduction target programs

Many states have mandated greenhouse gas emissions reduction goals that specify declining percentages of emissions over time relative to a baseline year, but these are rarely translated into specific guidelines for the gas industry. Table 7 presents some exceptions, showing how either annually declining emission limits or more aggregate methane targets can be set for gas utilities. However, further evaluation is needed to determine whether the standards set are sufficiently rigorous.

142 According to the Congressional Research Service, if natural gas distribution facilities were included, they would rank third in methane emissions across the entire spectrum of petroleum and natural gas system facilities. Congressional Research Service, [IRA Methane Emissions Charge: In Brief](#) (updated August 29, 2022), p. 1 and 6.

143 City of Burlington, VT, [“Resolution Relating to Implementation of a Carbon Pollution Impact Fee”](#) (January 9, 2023).

**Table 7: Examples of state methane reduction target programs**

**Massachusetts.** Two state policies aim to reduce fugitive emissions from gas distribution infrastructure. In 2022, the Commonwealth adopted statewide greenhouse gas emission sub-limits for gas distribution and services as components of the state's overall 2025 and 2030 statewide greenhouse gas emissions limits. The sub-limit requires an 82% reduction in emissions from distribution by 2025 relative to 1990 levels. In its April 2023 orders regarding the GSEP programs of six investor-owned utilities, the Department of Public Utilities notified each gas company that "in all future GSEP filings a detailed explanation for how its proposed filing is consistent with achieving the greenhouse gas emission sub-limits for Methane Gas Distribution and Services set forth in the Massachusetts Clean Energy and Climate Plan for 2025 and 2030" would be required.

The second policy was put into place in 2017 when the Massachusetts Department of Environmental Protection (MassDEP) established company-specific, annually declining methane emissions limits on gas utilities for 2018 to 2024 (310 CMR 7.73). The regulation supports the Commonwealth's Global Warming Solutions Act, which requires the state to reduce greenhouse gas emission levels by at least 80% below 1990 levels by 2050. By 2024, the six participating gas utilities are to reduce their aggregate methane emissions by 17% from their 2020 levels. Gas utilities can exceed their maximum allowable methane emission limits but still achieve compliance via a petition process that allocates set-aside emissions equal to roughly a quarter of the aggregate quantity of methane emission limits permissible in each year. If a gas utility exceeds its emissions limit and its set-aside petition is denied, it faces an administrative penalty. In each year from 2018 to 2021, the largest gas utilities have exceeded their limits and relied on set-aside petitions.<sup>144</sup>

**California.** Initiated by Senate Bill 137 in 2015, California's gas leak abatement program is being implemented in a phased approach. The 2025 and 2030 goals for reducing fugitive methane have been set at 20 percent and 40 percent, respectively, relative to 2015 levels. Utility progress in meeting these goals is tracked and reported via mandated annual reports to the CA Public Utilities Commission (CPUC). In 2019, the CPUC strengthened the program by restricting rate recovery for PG&E and SoCalGas, beginning in 2025, in the event of methane emissions greater than 20 percent below the 2015 baseline levels.<sup>145</sup>

**Connecticut.** A bill to establish sector-specific sub-targets for GHG emission reductions was introduced in 2023 and would require the Commissioner of Energy and Environmental Protection to establish sector-specific sub-targets for fossil gas distribution and service by January 1, 2025.<sup>146</sup> The bill responds to the most recent Connecticut inventory of statewide GHG emissions, indicating that the state is not on track to meet its 2030 and 2050 emissions targets.

<sup>144</sup> Calculations by author based on annual gas company filings with MassDEP.

<sup>145</sup> CPUC and CA Air Resources Board, [Analysis of the Gas Companies' June 15, 2022, Natural Gas Leak and Emission Reports](#), Joint Staff Report (January 5, 2023).

<sup>146</sup> Connecticut General Assembly, [An Act Concerning the Establishment of Sector Specific Subtargets for Greenhouse Gas Emissions Reductions and Regulating Emissions of Small-Off Road Engines](#) (January Session 2023).

## Federal electrification subsidy programs

At the federal level, the Inflation Reduction Act of 2022 created two main subsidy programs for electrification and energy efficiency relating to the residential building stock: HEERA (High Efficiency Electric Home Rebate Act) and HOMES (Home Owner Managing Energy Savings). The IRA also created substantial new tax deductions for electrification for both homeowners and commercial buildings.

- » **HEERA** provides a per household rebate capped at \$14,000. Qualified electrification projects include new construction purchases, replacement of nonelectric appliances, or first-time purchase of the appliance for heat pump HVAC systems, heat pump water heaters, electric stoves and cooktops, and heat pump clothes dryers. Non-appliance upgrades are also included, such as upgrading circuit panels, insulation, air sealing, ventilation, and wiring. Project costs covered include both purchase and installation costs, and the “point of sale” rebates are available over a period of ten years.
- » **HOMES** provides up to \$8,000 in rebates to low-income residents who cut their energy usage by at least 35 percent by purchasing energy-efficient electric appliances. The program provides rebates based on the energy savings that the upgraded home will achieve.

The IRA is the most significant action that Congress has ever taken on clean energy and climate change. With \$400 billion available over the next nine years, one of its key goals is to reduce carbon emissions by roughly 40 percent by 2030, relative to 2005 numbers. While it also incentivizes the continuation of some fossil fuel industries, it is hoped that it will lower clean energy costs through rebates, tax credits, and industrial subsidies, thereby accelerating the energy transition.

## C. Reducing gas end use through state and local policies

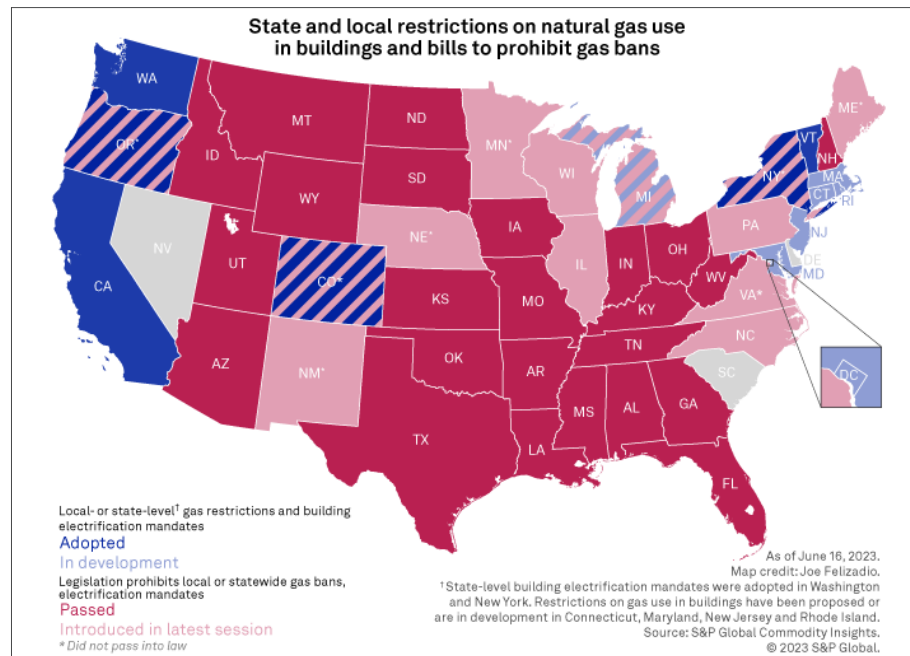
Important groundwork for the energy transition can be laid by state and local policies that promote cleaner, healthier, and safer housing stock. Cities can play a central role in this effort by setting standards and embedding specific goals that make local net-zero targets achievable and scientifically verifiable. Core to this vision is incentivizing electrification and limiting or prohibiting gas.

Over the last four years, more than 125 cities and counties in ten states and Washington, DC, have enacted policies that restrict or prohibit the use of gas in buildings.<sup>147</sup> However, these efforts have become increasingly politicized and polarized by policymakers backed by fossil fuel companies. As a result of pro-gas lobbying and media, legislatures in at least 24 states have passed ‘preemption bills’ designed to prohibit cities and counties from limiting the use of gas in buildings.<sup>148</sup> The map in Figure 11 shows the state of America’s civil energy divide.

<sup>147</sup> Leah Louis-Prescott and Rachel Golden, “[How Local Governments and Communities Are Taking Action to Get Fossil Fuels out of Buildings](#),” RMI (last updated October 2, 2023).

<sup>148</sup> Tom DiChristopher, “[Half of US states are on pace to prohibit local gas bans](#),” S&P Global Market Intelligence (June 21, 2023).

**Figure 11: States and local restrictions on natural gas use in buildings and bills to prohibit gas bans**



Source: [S&P Global Market Intelligence](https://www.spglobal.com/marketintelligence)

One learning from this backlash is that, while a fossil fuel “ban” may be an effective policy for reducing emissions, it may not constitute the best frame for maximizing support. A 23-country survey of climate framing and messaging found that “Frames that included the words mandate, ban or phaseout on average had 9 points lower support (and in some cases, up to 20 points lower support) than those that did not. Framings that included ideas like upgrading, setting standards, making solutions accessible, reducing pollution, and reducing dependency performed significantly better.”<sup>149</sup>

Clear guardrails and good messaging are key to any approach to reduce gas consumption and demand, including these three most in play:

- » Local building code changes and state legislative action to restrict or prohibit gas connections in new construction or for major renovations
- » Enhanced building performance standards
- » Enhanced equipment performance standards

<sup>149</sup> John Marshall et al., “[Later is Too Late](#),” Potential Energy Coalition (November 2023), pp. 6-7 and Table 5, p. 26. See also: John Marshall and Jessica Lu, “[Talk of banning gas stoves is fueling the flames](#),” That’s Interesting (January 17, 2023).

## Restricting or prohibiting gas connections for new construction and major renovations

Local or state moratoriums on new residential gas connections and disallowing reconnection to gas following major renovations impact only a small portion of the building stock, but they help accelerate efforts to restrict or reduce demand. The main vehicle for these restrictions has been amending building codes at the city, county, or state level or through state legislative action (see Table 8 for examples).

Table 8: Local and state efforts to restrict gas use in new construction	
<b>Local efforts</b>	
<b>Berkeley, CA</b>	became the first city to amend its building code in 2019 to prohibit the installation of gas piping in newly constructed buildings. Approximately 100 jurisdictions have followed suit, including San Francisco, Seattle, and Washington, DC. <sup>150</sup> A legal setback to this approach occurred in April 2023 when a federal appellate court voided the Berkeley, CA, ban on gas in new buildings in a lawsuit brought by the California Restaurant Association. <sup>151</sup> In January 2024, a federal appeals court declined to rehear the case which means that the prior judgment is now final unless Berkeley chooses to appeal the case to the U.S. Supreme Court.
<b>Los Angeles</b>	requires newly constructed buildings to be all-electric, with limited exceptions, including commercial kitchens and backup generators. <sup>152</sup>
<b>San Francisco</b>	requires newly constructed buildings to be all-electric with limited exceptions, such as for commercial kitchens. <sup>153</sup>
<b>Seattle</b>	banned the use of gas for space heating in new residential and commercial buildings and prohibits the use of gas to heat water in new apartments. <sup>154</sup>
<b>New York City</b>	is now the largest city in the world to phase fossil fuels out of new construction starting in 2024, including buildings used for manufacturing, hospitals, commercial kitchens, and laundromats. <sup>155</sup>
<b>State efforts</b>	
In <b>Massachusetts</b> , the Legislature in 2022 directed the state Department of Energy Resources (DOER) to establish a demonstration project that would allow up to ten cities and towns to pass ordinances or bylaws that restrict fossil fuel use in new construction. <sup>156</sup> The DOER is expected to provide application approval in 2024. This petition was the result of several years of work by municipal leaders who first had to pursue a home rule petition to address this issue, given the state's laws.	
<b>New York State</b> in 2023 enacted the nation's first legislative ban on gas and fossil fuel appliances in most new buildings, including single-family homes. The ban takes effect in 2026 for most new buildings under seven stories and in 2029 for taller buildings. <sup>157</sup> Later in the year, gas and construction trade groups—the National Association of Home Builders and the National Propane Gas Association, among others—sued to block the ban, arguing that the new law violates federal law.	

150 Maria Gallucci, "[Berkeley's landmark gas ban overturned, ripple effects may be limited](#)," Canary Media (April 18, 2023).

151 The Association argued that the ban is preempted by the federal Energy Policy and Conservation Act (EPCA), which gives the Department of Energy authority to set energy conservation standards for appliances such as furnaces and water heaters. Berkeley argued that the EPCA's pre-emption only covers regulations imposing standards on the design and manufacture of appliances, not regulations that impact the distribution and availability of gas. The new Berkeley ruling does not apply outside the nine states and two territories of the 9th Circuit or jurisdictions that have taken different building-code approaches from Berkeley's gas ban.

152 City of Los Angeles, Department of Building and Safety, "[All-Electric Buildings Ordinance](#)."

153 City of San Francisco, "[All-Electric New Construction Ordinance](#)."

154 James Brasuell, "[Seattle Limits Natural Gas in New Construction](#)," Planetizen (February 11, 2021).

155 City of New York, New York, Office of the Mayor, "[Mayor de Blasio Signs Landmark Bill to Ban Combustion of Fossil Fuels in New Buildings](#)" (December 22, 2021).

156 Massachusetts DOER, "[Municipal Fossil Fuel Free Building Demonstration Program](#)," and Boston Municipal Research Bureau, "[Potential Fossil Fuels Ban on New Development](#)" (February 10, 2023).

157 Liam Stack, "[New York to Ban Natural Gas, Including Stoves, in New Buildings](#)," *The New York Times* (April 28, 2023).



While policies restricting or prohibiting gas are being tested and contested, they are also raising awareness and changing the conversation about the future of gas. Thoughtfully implemented, with planning for gas workers, EJ communities, and other stakeholders, they could become an important tool for reducing methane emissions and spurring an energy transition focused on non-emitting, non-combusting solutions, equitable access, and quality jobs.

### Enhanced building performance standards

Building performance standards typically apply to large public, commercial, and multifamily buildings. These policies require owners to select the upgrades they prefer to meet specified emissions or energy thresholds by a certain date. Boston, Maryland, and New York City have adopted enhanced standards to encourage electrification and energy efficiency upgrades to building envelopes (see Table 9).

**Table 9: Examples of enhanced building performance standards to reduce emissions**

In **Massachusetts**, Boston's [Building Emissions Reduction and Disclosure Ordinance](#) (BERDO) requires large, existing commercial and multifamily buildings to gradually reduce their emissions to zero, with varying compliance dates based on building size. Building owners failing to comply must pay a fee to a fund that invests in EJ populations affected by climate pollution. Enacted in 2021, this community-led compliance solution replaced traditional carbon offsets. The City of Cambridge has an even more ambitious building ordinance (amended in June 2023) called the [Building Energy Use Disclosure Ordinance](#) (BEUDO): large and mid-size non-residential buildings must be net-zero by 2035 and 2050, respectively.

In **Maryland**, buildings over 35,000 square feet must achieve a 20 percent reduction in net direct GHG emissions (produced on-site) by 2030 (relative to average 2023 emissions for buildings of similar type) followed by zero emissions by 2040.<sup>158</sup>

In **New York City**, Local Law 154 sets carbon dioxide limits that effectively prohibit fossil fuel systems in new buildings and gut renovations.<sup>159</sup> The requirements are phased in with compliance for lower-rise buildings starting in 2024 and taller buildings in 2027. This law also impacts appliances such as domestic cooking ranges and clothes dryers.

At the federal level, the new \$1 billion Department of Energy (DOE) Technical Assistance for Building Energy Codes Program under the Inflation Reduction Act is available to assist states and municipalities in developing and implementing building performance standards to reduce emissions from existing buildings over time.<sup>160</sup> The program provides grants to help states and localities adopt building codes that meet or exceed the 2021 International Energy Conservation Code for new and renovated residential or commercial buildings.

<sup>158</sup> MD Department of the Environment, [Building Energy Performance Standards](#).

<sup>159</sup> See City of New York, NY City Buildings, [Building Electrification](#).

<sup>160</sup> DOE, Office of State and Community Energy Programs, [Technical Assistance for the Adoption of Building Energy Codes](#).



## Enhanced equipment performance standards

The Bay Area region of California is leading on statewide zero-emission standards for gas furnaces and water heaters. In March 2023, the Bay Area Air Quality Management District approved new rule amendments that require water heaters and furnaces to be pollution-free starting with compliance dates ranging from 2027 to 2031 for different types of devices.<sup>161</sup> These rules represent the nation's first zero-emission appliance standard for furnaces and water heaters. Target pollutants are the nitrogen oxides (NO<sub>x</sub>) released from combusted gas and the ozone and secondary particulate matter (PM) formation to which NO<sub>x</sub> contributes. Together these pollutants cause acid rain and smog, increasing risks of asthma and other respiratory diseases. While the regulation does not apply to gas stoves and ovens, which produce less NO<sub>x</sub>, the intent is to gradually phase out the sale of gas furnaces and water heaters over the next 25 years (property owners only have to change appliances when they break and cannot be repaired).<sup>162</sup> The new rules are expected to substantially reduce NO<sub>x</sub> emissions from space and water heating appliances, avoiding up to 137 premature deaths annually. The estimated health benefits range up to \$890 million.<sup>163</sup>

In another first for the country, the California Energy Commission has submitted draft language for the state's 2025 Energy Code that would require contractors to either install a heat pump to replace a broken air conditioner or make additional efficiency upgrades to the existing HVAC unit that are specified in the regulation.<sup>164</sup> The Commission aims to quadruple the number of homes with heat pumps to 6 million by 2030 to support the state's timeline for reducing GHG emissions.<sup>165</sup>

Continued use of gas presents a complex set of issues and offers several ways to attack emissions: via effective leak repair, focusing on significant leaks, reducing demand, limiting customer choice, or banning use. Whether policy levers include penalties, incentives, or both, they also need to address jobs that are otherwise lost and communities that are often overlooked. The most effective means of reducing emissions must also be cost-effective. Considering the factors in play and the pace at which emissions must be reduced means that downsizing the gas system requires not only science and economics, but also a holistic strategy to ensure that investments yield sustainable, equitable results.

<sup>161</sup> Bay Area Air Quality Management District, [Rules 9-4 and 9-6 Building Appliances](#).

<sup>162</sup> For estimates of the electric infrastructure impacts of the rule amendments, see E3, "[Bay Area Air Quality Management District Historic Zero-NOx Appliance Rules](#)" (March 24, 2023).

<sup>163</sup> Bay Area Air Quality Management District, [Final Staff Report for Proposed Amendments to Regulation Rules 9-4 and 9-6](#) (March 2023).

<sup>164</sup> Ari Palchta, "[California may require homeowners to replace broken A/C units with heat pumps starting in 2026](#)," The Sacramento Bee (December 6, 2023).

<sup>165</sup> CA Energy Commission, [Staff Workshop Heat Pump Goals, Supply Chain, and Programs](#) (April 5, 2022).

## V. Steps to a Managed Gas System Transition

Side by side with the near-term action steps reviewed in Section IV, states must launch long-term gas planning processes and rulemaking that provide clear direction regarding how to minimize future gas infrastructure investments and downsize gas networks in order to rapidly reduce and eventually eliminate GHG emissions from the residential, commercial, and industrial sectors. The gas system transition presents a considerable challenge and will require regulatory change on an unprecedented scale and coordinated planning across gas and electric utilities.

This section introduces the concepts of a “managed” versus “unmanaged” gas system transition and the keystone building block of a managed approach: a neighborhood, street-segment approach to electrification. It also surveys the state of decommissioning thinking across the country and investigates efforts across the country to halt further build-out of gas distribution infrastructure. Finally, the case for prioritizing the transition from gas for lower-income residences and EJ communities is presented. As decommissioning and halting the expansion of the gas system proceeds, these households should not be an afterthought. Instead, by focusing on low-income households as a core element of a managed transition, substantial energy and emissions savings can be achieved while delivering impactful economic, health, and social benefits.

### A. Downsizing the gas system: A managed, phased approach

#### Managed versus unmanaged gas transition

Strategically downsizing the gas system in a managed and phased way will ultimately be safer, more cost-effective, and more equitable than relying on individual choice and house-by-house transitioning.<sup>166</sup> It can be organized to provide customers with coordinated access to energy-efficient heating and cooling technologies. While some sections of the gas system will need to be maintained during the transition, successive phases of targeted pruning and zonal transitions can take advantage of efficiencies and opportunities for coordinated investments on a hyperlocal or neighborhood-level basis.<sup>167</sup>

Decommissioning segments of the gas system that are targeted for pipeline replacement is another complementary near-term strategy that avoids reinvestment. Safety and reliability are key requirements during the gas transition. Gas utilities must be vigilant to address hazardous leaks, and distribution pipelines can only be retired where hydraulically feasible, meaning that a pipeline segment can be isolated and retired without negatively impacting the rest of the system (for example, by cutting off gas access or substantially reducing pressure or reliability).

<sup>166</sup> Kristin George Bagdanov, Claire Halbrook, and Amy Rider, [Neighborhood Scale: The Future of Building Decarbonization](#), BDC and Gridworks (December 2023).

<sup>167</sup> Michael J. Walsh and Michael E. Bloomberg, [The Future of Gas in New York State](#), BDC (March 2023).

An unmanaged downsizing of the gas system will result in building upgrades, weatherization, and electrification that occur one house at a time, building by building, in an uncoordinated way. An unmanaged migration is arguably already underway as those who can afford cleaner, more efficient, technologies leave the gas system. Under this scenario, the gas distribution system must be maintained to serve remaining ratepayers, locking in sizable ongoing infrastructure and operational costs even though gas assets would be increasingly underutilized. Higher per customer costs will necessarily result from a shrinking customer base as the fixed costs of the gas system are spread across a shrinking number of customers, thereby increasing inequitable outcomes for those whose energy bills are a larger fraction of their income.

The current scattershot approach to building upgrades, weatherization, and electrification is making slow progress at best. Instead, replacing this house-by-house incremental approach with a more rapid, scalable block-by-block or clustered solution could retrofit and electrify all building sectors, particularly low-income housing. Strategic expansion and coordination of existing programs would more effectively address housing repair needs and bring clean space and water heating technology to the most energy-burdened households.

### A neighborhood, street-segment approach to electrification

The companion to strategic gas system decommissioning is street-segment electrification. Electrifying clusters or groups of homes and businesses via air source heat pumps, thermal energy networks, and community solar has the potential to maximize outreach dollars, socialize changes, and increase participation. A community-scale approach also allows entire sections of pipeline to be capped and taken offline.

### Clustered electrification paired with gas pipeline retirement brings clear benefits:

- » It is more efficient and cost-effective, realizing important economies of scale related to coordinated, pooled purchasing and contractor work.
- » Clustering allows electric utilities to better match and pace any needed load capacity investments, including incorporating thermal energy networks that can lower peak loads and reduce the need for local transmission upgrades.<sup>168</sup>
- » Gas utilities can plan for cost-effective, strategic asset retirement, thereby avoiding both interim pipeline maintenance costs and expensive capital replacement costs, and lowering the risk of stranded assets.
- » Synchronizing clustered electrification with strategic gas system decommissioning delivers a faster pace and higher success rate for reaching states' aggressive emissions reductions targets.<sup>169</sup>

<sup>168</sup> "Rather than investing to raise the distribution capacity on an ad hoc basis driven by scattered electrification (which risks needing to rebuild as further electrification occurs) the utility could adjust the distribution network for a known new long-term load in a given area, then move to the next." Asa Hopkins, Alice Napoleon, Kenji Takahashi, [Gas Regulation for a Decarbonized New York: Recommendations for Updating New York Gas Utility Regulation](#) (June 29, 2020, prepared for NRDC by Synapse Energy Economics, Inc.), p. 26.

<sup>169</sup> Lucas Davis and Catherine Hausman, "[Who Will Pay for Legacy Utility Costs?](#)" Energy Institute at Haas, University of California at Berkeley (March 2022), p. 38.

## Long-term gas planning rulemaking and projects

As reviewed in Section III.B, 11 states and the District of Columbia have undertaken or are in the midst of future-of-gas investigations. A smaller number of states (e.g., California<sup>170</sup> and New York<sup>171</sup>) are taking the next step: initiating regulatory rulemaking proceedings for long-term gas planning. A key issue in these proceedings is determining what criteria and methodologies should be used for prioritizing pipes for retirement. Specifically:<sup>172</sup>

- » What criteria should be used to determine which distribution lines should have the highest priority for decommissioning?
- » What criteria should the Commission use to determine whether aging distribution infrastructure should be repaired or replaced?

To create selection criteria for retiring gas lines, policy goals need to be translated into geographic criteria. These could reflect safety and climate concerns such as whether the lines are leaking, aging, or in line to be replaced. Community characteristics are also relevant, for example, the presence of high household energy burdens, environmental and health burdens, economic burdens, affordability, low housing quality, and gas usage. Examples of criteria currently under consideration in California include:<sup>173</sup>

- » Higher pipeline risk
- » Higher existing environmental health burden
- » Higher gas infrastructure cost savings
- » Lower energy and community affordability, as reflected in measures like rent burden
- » Higher gas demand

California's Public Utilities Commission (CPUC) proposes using these criteria to classify all census tracts with distribution infrastructure into five tranches in descending order of prioritization for decommissioning.<sup>174</sup> Decommissioning would begin with "areas likely to see the highest benefits from decommissioning and the most immediate potential to decommission, proceeding over time to the fifth tranche consisting of difficult-to-electrify customers where the potential benefit from decommissioning is the lowest. The CPUC has also adopted a new framework to comprehensively review utility gas infrastructure investments in order to help the state transition away from gas-fueled technologies and avoid stranded assets in the gas system. Utilities must now seek CPUC approval of gas infrastructure projects of \$75 million or more or those with significant air quality impacts. Previously, all gas infrastructure projects were considered in utility general rate cases, "where individual natural gas projects can get buried in the extensive

<sup>170</sup> The general website for "Long-Term Gas Planning Rulemaking" in California; and the specific [order instituting rulemaking](#).

<sup>171</sup> NY PSC, [Order Adopting Gas System Planning Process, Proceeding on Motion of the Commission In Regard To Gas Planning Procedures](#) (May 12, 2022).

<sup>172</sup> CPUC, [Staff Proposal on Gas Distribution Infrastructure Decommissioning Framework in Support of Climate Goals](#) (December 21, 2022).

<sup>173</sup> *Ibid.*, p. 3.

<sup>174</sup> *Ibid.*, pp. 3-4, 16-18.

applications without meaningful environmental review.”<sup>175</sup> Emergency projects, routine repair and maintenance projects, and projects expected to be in service by January 1, 2024, are exempt from the new review process.

### **Decommissioning is under active consideration or study in several areas of the country:**

California’s Climate Energy Commission has established a Tactical Gas Decommissioning Project that is developing a “data-driven actionable tool” to identify segments of a given gas distribution system that, if decommissioned, would result in gas system cost savings.<sup>176</sup> A report has been conducted to develop benefit-cost analytics and data requirements for identifying and evaluating candidate pilot sites for future gas decommissioning and targeted electrification. The study evaluates 11 candidate sites in the San Francisco Bay Area and finds that, for each site, “considerable cost savings could be achieved even after paying for building electrification.”<sup>177</sup> The avoided cost of gas main and service replacement play a substantial role in the costing framework. Planning for pilots is underway in three communities.<sup>178</sup>

In 2020, the City of Palo Alto assessed the cost of decommissioning its gas system serving all of the City’s 15,000 single-family dwellings,<sup>179</sup> including sealing valves to the gas mains, disconnecting gas service laterals to individual homes, and removing gas meters and risers. Costs were found to range between \$1.1 million and \$5.4 million per year over ten years, compared to a gas utility’s capital investment budget of approximately \$8 million to \$10 million per year. Additional savings of \$26 million to \$34 million were identified from not having to replace gas mains and service lines. Notably, the lower estimates represent lower costs for disconnecting an entire block from gas service at once versus disconnecting one home at a time.

In Massachusetts, the U.S. Department of Energy funded a study to provide the City of Holyoke, the second poorest city in the state, with a framework for evaluating alternative strategies for managing the extensive city’s leak-prone gas pipeline infrastructure in the context of an equitable energy transition. The strategies range from continued gas use with pipeline replacement to pipeline decommissioning with accelerated electrification. The framework presents a methodology for identifying, evaluating, and prioritizing the street segments best suited for decommissioning. The study finds that the cost of pipeline replacement ranges from \$20,000 to \$30,000 per household and that coordinated, segment-level transition off of gas (including building retrofits) can be cost effective.<sup>180</sup> A statewide study for the MA Department of Energy Resources is forthcoming.<sup>181</sup>

175 CPUC, “[CPUC creates new framework to advance California’s transition away from natural gas](#),” News and Updates (December 1, 2022).

176 CA Energy Commission, [Staff Workshop on Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Natural Gas Infrastructure](#) and GFO-21-504 - Development of a Data-Driven Tool to Support Strategic and Equitable Decommissioning of Gas Infrastructure.

177 Aryeh Gold-Parker et al., “[Benefit-Cost Analysis of Targeted Electrification and Gas Decommissioning in California: Evaluation of 11 Candidate Sites in the San Francisco Bay Area](#),” California Energy Commission (December 2023), p. 9.

178 Gridworks, “[Site Prioritization: Identifying Three Proposed Gas Decommissioning Pilot Locations](#).”

179 City of Palo Alto Utilities Advisory Commission, [Discussion of Electrification Cost and Staffing Impacts on the City of Palo Alto’s Electric and Gas Distribution Systems](#) (November 4, 2020).

180 UMass Amherst Energy Transition Institute, [Equitable Energy Transition Planning in Holyoke Massachusetts: A Technical Analysis for Strategic Gas Decommissioning and Grid Resiliency](#) (December 2023, prepared by Groundwork Data).

181 MA DOER, Thermal Transition Strategy Study: A Framework for Evaluating Non-Pipeline Gas Alternatives to Gas Pipeline Replacement (forthcoming 2024, prepared by Groundwork Data).

In Washington, DC, [Rewiring America](#) provided a blueprint for a managed decommissioning approach to the existing gas grid with corresponding clustered electrification of the city blocks, multifamily dwellings, and municipal buildings most in need.<sup>182</sup> This proposal comes amid growing concern in the District about fugitive emissions and the fact that, despite millions of dollars of investment to replace gas pipelines, the rate of gas leaks appears to be worsening.<sup>183</sup> More recently, a study for the District's Department of Energy & Environment (DOEE) created seven neighborhood case studies comparing strategic electrification to pipe replacement from a cost and climate mitigation perspective. The report compares pipe replacement to the cost savings from two leak repairs conducted in the District. It describes the cost-effective role that enhanced leak monitoring and repair of the largest leaks can play in a "triage and transition" strategy wherein "an existing pipeline network is managed for retirement with resulting cost savings funneled into financing electrification equipment and/or infrastructure."<sup>184</sup> In 2023, the DOEE released a detailed roadmap for strategically electrifying buildings and transportation in the District, based on the understanding that phasing fossil fuels out of the District's energy supply is essential to achieving the city's climate commitments.<sup>185</sup>

## B. Halting expansion of the gas system

Often forgotten in the focus on replacing leak-prone or vintage gas pipes is the fact that gas utilities continue to extend substantial subsidies or allowances to attract new customers, either by laying new pipeline or through customer conversions. While the original rationale was that an expanding customer base would benefit the system and lower long-run rates, these types of incentives are now antithetical to both emissions reduction goals and to the policy objective of downsizing the gas system. Curtailing further expansion of the gas system requires ending these financial advantages as well as the marketing, lobbying, and political activities that support them.

### Line extension allowances (LEA) and customer conversions to gas

State regulators typically allow gas utilities to provide allowances to cover all or some of the costs of laying new gas pipe to connect a new customer. Sometimes these payments are based on the number of gas appliances anticipated in a new customer's residential dwelling or the projected use of gas by new commercial and industrial facilities (i.e., the more gas appliances installed or the higher the gas use, the greater the subsidy). Some states have a "100 foot rule" under which new residential gas customers do not have to pay any cost for a new gas line that is no more than 100 feet long. This funding is provided free to new customers and is paid for by current ratepayers via an increase in rates. Utility spending on these subsidies can be substantial. For example, from 2017 to 2021, existing New York gas customers spent \$1 billion subsidizing the expansion of the

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182 Stephen Pantano & Sam Calisch (Rewiring America) and Daniel Munczek Edelman (Next100), [Electrification Study for the District of Columbia](#) (2021).

183 Bob Ackley and Nathan Phillips, [2021 Fugitive Methane Emission Survey of the District of Columbia](#) (November 2021, DOEE).

184 Bob Ackley and Nathan Phillips, [Strategic Electrification in Washington, DC: Neighborhood Case Studies of Transition from Gas to Electric-Based Building Heating](#) (February 2023, DOEE).

185 DOEE, [The Strategic Electrification Roadmap for Buildings and Transportation in the District of Columbia](#) (April 2023).

state's gas system.<sup>186</sup> In California, gas ratepayers have been paying an estimated \$164 million per year for gas line extensions.<sup>187</sup> Some states are taking steps to dismantle these subsidies (see Table 10).

**Table 10: Examples of state efforts to reduce line extension allowances**

The **California Public Utilities Commission** voted to end subsidies that connect new buildings to the gas system, effective July 1, 2023. The CPUC argued that this decision results in “significant reductions in GHG emissions but also improved quality of life and health for customers, hundreds of millions of dollars in ratepayer savings annually, greater equity for low-income customers, and greater certainty for builders, developers, and individual customers.”<sup>188</sup>

**Oregon,<sup>189</sup> Washington,<sup>190</sup> and Colorado** recently cut back subsidies for gas-system expansion for some utilities. Utilities in Oregon and Washington “connected 61,000 residential customers to the gas system in 2020 and 2023, a roughly 3 percent increase from 2019 counts. Ratepayers in these states likely paid more than \$100 million a year to cover the cost of the subsidies that made those new connections possible.”<sup>191</sup> The Colorado Public Utility Commission took a middle road between gas companies and environmental advocates, finding that “load growth since 2015, the statutory baseline for clean heat targets..., is largely incompatible with greenhouse gas emission reductions and is likely to make compliance with the clean heat targets more difficult or costly for gas utilities.”<sup>192</sup>

**Connecticut** regulators in April 2022 ordered the immediate winding down of the state's System Expansion Program (SEP), which subsidized line extensions and the conversion of residences and businesses from heating oil (or propane) to gas. SEP aimed to convert approximately 280,000 additional residences and businesses in Connecticut to gas over a ten-year period ending in 2024. The program was found to be no longer cost-effective nor compatible with the state's climate goals.

## Fuel-switching prohibitions and incentives for fossil fuel systems and appliances

While some states have adopted innovative energy efficiency program design structures, traditional gas utility energy efficiency programs—which are funded by surcharges on customer bills—provide basic weatherization and energy efficiency services and products such as LED light bulbs and smart thermostats. The vast majority do not reward energy or emissions savings resulting from fuel switching to electricity. Instead, they often discourage or prohibit fuel switching and provide subsidies for the purchase of gas-fired appliances and heating equipment.<sup>193</sup> Two recent analyses critique the fossil fuel incentives and fuel-switching prohibitions of specific state utility energy efficiency programs:

186 Meagan Burton, “[The gas industry is raising your rates to expand their polluting system: The NY HEAT Act will end that.](#)” Earthjustice (March 31, 2023).

187 Kavya Balaraman, “[California becomes first state to eliminate subsidies for gas line extensions amid electrification push.](#)” Utility Dive (September 16, 2022).

188 CPUC, [Phase III Decision Eliminating Gas Line Extension Allowances](#) (August 8, 2022), p. 2.

189 OR PUC, [Disposition in the matter of Northwest Natural Gas Company](#) (October 24, 2022).

190 Washington Utilities and Transportation Commission, [In the Matter of ... Natural Gas Line Extension Allowances](#) (October 29, 2021).

191 Laura Feinstein and Emily Moore, “[It's Time to Stop Subsidizing New Gas Pipes.](#)” Sightline Institute (January 17, 2023).

192 CO PUC, [Proceeding NO. 21R-0449G, Decision No. C22-0760 download](#) (2022), p. 55.

193 Sherri Billimoria and Mike Henchen, [Regulatory Solutions for Building Decarbonization: Tools for commissions and other government agencies](#), RMI (2020); and Weston Berg, [State Policies and Rules to Enable Beneficial Electrification in Buildings through Fuel Switching](#), ACEEE (2022).



- » **Regarding EmPOWER in Maryland:** “Unfortunately, EmPOWER Maryland’s current goals are focused specifically on reducing electricity consumption.” Incentives for gas equipment, including higher-efficiency gas furnaces, “discourage Marylanders from switching to electric appliances.”<sup>194</sup>
- » **Regarding Mass Save in Massachusetts:** “Mass Save is structured primarily to support cost savings from energy efficiency and not to achieve building decarbonization/electrification; as a result, Mass Save continues to support fossil-fuel heating systems and typically does not support deep enough retrofits or related technologies (such as solar, EV chargers, storage).”<sup>195</sup>

A further barrier posed by many utility efficiency programs is that benefits are skewed toward higher-income households, resulting in program funds being disproportionately directed to those ratepayers rather than low- to moderate-income ratepayers.<sup>196</sup> Additionally, specific equipment subsidies (say, for a heat pump) may not be equally available to lower-income households or renters as they are to higher-income owner-occupied households.<sup>197</sup>

Ending subsidies that further the growth of the gas system and the continued use of fossil fuel appliances and equipment are a necessary part of an effective gas system transition.<sup>198</sup> Eliminating these fossil fuel incentives will help:

- » Reduce GHG emissions, as every added customer means more emissions to be reduced
- » Reduce the risk exposure of customers to stranded costs, as ending growth subsidies will result in fewer new gas assets
- » Create ratepayer savings, as rates will not be increased to pay the subsidies given to developers and homeowners to hook up to new gas lines

## C. Prioritizing the energy transition for lower-income households and environmental justice communities

The lower-income housing sector and EJ communities are in urgent need of a managed transition off of gas. Households in these communities are struggling to afford the high energy bills that result from the poorly insulated spaces and energy-inefficient buildings they rent or own. Heating and AC systems are often outdated and inefficient, contributing to poor air quality due to incomplete combustion or improper venting. Unhealthy housing

194 Emily Scarr et al., [Energy Efficiency for Everyone](#), Maryland PIRG Foundation and the Frontier Group Winter (2023), p. 13.

195 Commonwealth of Massachusetts, Office of Climate Innovation and Resilience, [Recommendations of the Climate Chief](#) (October 25, 2023).

196 In the case of Maryland’s EmPower Program, for example, a recent study found a gross imbalance between what low-income ratepayers paid into the program (\$50 million annually) and the benefits they actually received (\$28 million). MD PSC, [Future Programming Work Group Report](#), 2021-2023 EmPOWER Maryland Program (April 15, 2022), p. 31.

197 Currently under the [Mass Save program](#), the \$10,000 whole home heat pump rebate is only allowed for owner-occupied homes. Rental units only qualify for the \$1,250/ton incentive. This is a reduction of \$6,250 for an average Massachusetts home. Heat pump incentives are not allowed at all for low-income properties that currently use gas.

198 Kiki Velez, [California’s Building Transition: Recommendations for Gas Transition Regulatory Proceedings](#), BDC (January 2021).



due to neglected structural repairs, leaks and mold, pests, and lead paint contributes to a variety of chronic diseases, including asthma, and can increase vulnerability to other diseases.<sup>199</sup> Indoor and outdoor gas leaks and other sources of local air pollution exacerbate these adverse health impacts.

Low-income households face a disproportionately higher energy burden, spending 9 percent of their income on energy bills, or three times more than non-low-income households.<sup>200</sup> Nearly 30 percent of American households are energy insecure, meaning that they forgo paying for food or medicine in order to pay an energy bill, keep their homes at an unsafe or unhealthy temperature, are unable to use their heating or AC equipment because it is broken and they cannot afford to fix it, or have received disconnection or delivery stop notices.<sup>201</sup>

### Three key dynamics are shaping the energy future of these households:

- » Low-income households and EJ communities are at substantial risk of being left behind on an aging, underutilized gas network facing unsustainable increases in gas rates. Lower-income customers are most likely to be the remaining gas customers repaying these investments via gas bill tariffs and surcharges, while households with greater resources electrify their homes and leave the gas system.
- » The dominant policy response to the energy burden faced by lower-income households is federal and state bill payment assistance. This assistance is a critical social protection policy that helps families meet basic energy needs. But it does not address the root causes of household energy insecurity and deflects attention from the underlying need for help with whole-home retrofits. Some households only need bill assistance once, but many households depend on it annually or seasonally due to increasing utility bills, persistent insufficient income, and/or because their homes have structural deficiencies such as lack of insulation, outdated windows, and inefficient heating and cooling equipment, leading to higher energy costs.
- » Utility and state energy efficiency programs, as currently structured and funded, will at best make incremental progress at the edges of state low-income housing challenges and energy injustices. A fundamental barrier to greater participation is the inability of existing programs to address the non-incidental disrepair and significant health/safety issues that many housing units present—in other words, the need for whole-home retrofits. Examples of other barriers are disallowing heat pump incentives for low-income housing authorities and non-owner occupied homes, and disallowing income-qualified rebates for customers with pre-existing gas heating.<sup>202</sup> The low-income housing sector will be largely left out of the benefits of full weatherization and clean space and water heating technologies until solutions to this challenge are implemented.

199 Sara Hayes et al., [Pathways to Healthy, Affordable, Decarbonized Housing: A State Scorecard](#), ACEEE (August 18, 2022), p. 64.

200 U.S. Department of Energy, Office of State and Community Energy Programs, [Low-income Energy Affordability Data Tool](#).

201 EIA, 2020 RECS Survey Data, "[Highlights for household characteristics of U.S. homes by state, 2020](#)."

202 An example of a utility program with some of these barriers is the [Mass Save Program](#). See the notes with asterisks indicating that, to be eligible for income-qualified rebates, "pre-existing fuel type must be oil, propane, or electric resistance."

Given that households with annual incomes below \$60,000 account for over half (52 percent) of all residential energy consumption,<sup>203</sup> the success of the energy transition depends on making building decarbonization accessible to low-income homes in particular. States can bring clean, energy-efficient space and water heating technologies to lower-income and EJ households by leveraging Justice40 programming,<sup>204</sup> which provides considerable new federal resources to accomplish deep retrofits plus electrification. Pilots in cities with large concentrations of lower-income, energy-burdened households relying on gas for heating can serve those most in need first. In addition, states can rectify the gross imbalance between spending on “enduring assistance” (e.g., weatherization and electrification) versus “temporary assistance” (e.g., for bill payments).<sup>205</sup> Only a very small proportion of lower-income households in the United States is likely to receive some degree of comprehensive weatherization and energy efficiency services through state programs. While both forms of assistance are critical and must be linked, this imbalance is a stark indicator of the energy burden born by disadvantaged communities and the lack of prioritization to bring clean space and water heating technologies to these neighborhoods.

Lower-income and EJ communities do not need to be left behind. An unprecedented infusion of new federal resources gives policymakers a never-before opportunity to launch a building electrification movement to reverse decades of underinvestment in disadvantaged communities.<sup>206</sup> With a significant proportion of these funds tied to Justice40, states have the opportunity to create a new strategic pathway to energy equity. The economics of moving away from gas and achieving a managed transition have never been better.

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203 EIA, Office of Energy Demand and Integrated Statistics, [2020 Residential Energy Consumption Survey](#), Table CE11.

204 [Justice40](#), an Executive Order of the Biden Administration, mandates that at least 40% of the benefits of certain federal investments must flow to disadvantaged communities.

205 Marilyn A. Brown et al., “[High energy burden and low-income energy affordability: conclusions from a literature review](#),” *Progress in Energy* (2020), p. 24.

206 For a comprehensive state-based proposal to electrify the low-income housing sector in Maryland, see Ashita Gona et al., [Charting a Pathway to Maryland's Equitable Clean Energy Future](#), Earthjustice, Green & Healthy Homes Initiative, RMI, and Sierra Club (January 2023).

## VI. Key Building Blocks for Comprehensive State and Local Action

This report lays out the complex landscape of downstream methane emissions in the United States, linking it to the entire gas supply chain. The subject matter is not simple—it involves an interconnected set of scientific, economic, public policy, regulatory, and political topics. How much methane is being emitted and from what sources? What does science tell us about the effects of these emissions? How is climate change and the emerging energy transition changing the economics of gas? And how is the gas industry responding to these challenges? Most importantly, what can citizens, community groups, scientists and researchers, town officials, state policymakers, and utility regulators do to deeply reduce and eliminate methane emissions and redirect gas-based energy systems to a new energy future based on reduced energy demand, decarbonized electricity, and electrification?

This final chapter provides the report’s key takeaways and synthesizes strategic action steps in play at local, municipal, and state levels for lowering methane emissions and phasing fossil gas out of our energy supply.

### A. Key takeaways

1. **Methane emissions are a key driver of climate change and a critical lever for slowing global warming.** Any further expansion of gas infrastructure and usage is incompatible with limiting global warming to 1.5°C, and this goal cannot be reached without slashing methane emissions by at least 40-45 percent by 2030 compared to 2020 levels.<sup>207</sup> But in 2021, methane emissions rose more than in any other year on record and then remained high in 2022.
2. **Methane emissions are substantially underestimated, hampering our ability to tackle the climate crisis at the speed needed to avert the worst consequences.** The EPA and state GHG inventories rely on outdated emission factors and fail to convey with scientific accuracy the actual size of methane emissions from the gas system. Gas companies tie their public GHG reporting to these official inventories and methodologies, allowing them to claim declining emissions through the narrow lens of pipeline replacement. The result: actual corporate carbon damages caused by the gas industry are severely understated by a factor of two to six, and “natural” gas may be contributing as much as “dirty” coal to climate change.
3. **The gas industry does not bear the social costs of the gas it delivers, even though these costs to society are massive, both in terms of health and climate damages.** On a per therm basis, the social cost of leaked methane—according to the most recent estimates of the EPA and using a 20-year global warming

<sup>207</sup> UN Environment Programme/Climate and Clean Air Coalition, Global Methane Assessment: [2030 Baseline Report Summary for Policymakers](#) (2022).

potential for methane—is roughly equal to the supply cost of gas. In other words, if gas prices were to truly price in their social cost, they would need to double, rendering the vast majority of gas utility assets uneconomic. Meanwhile, because the true costs of fossil gas are hidden, business-as-usual investment decisions, such as installing new gas pipeline, appear less expensive than they really are because the full cost of damages is not factored in.

- 4. If gas utilities continue their expensive pipeline replacement programs at current spending levels, U.S. ratepayers would owe over \$1 trillion (\$2022) to gas companies for distribution infrastructure investments between 2015 and 2040, inclusive of rates of return to investor-owned utilities.** Continued high levels of capital spending on the gas system are likely to have devastating outcomes for residential and small business gas customers, burdening ratepayers for decades to come. And as customers leave the gas system to adopt cleaner, more efficient electric heating, rates will need to increase even further to cover lost customer revenue.
- 5. The gas industry’s long-term financial prospects are increasingly tenuous as the underlying economics of gas head toward deep disruption.** In its latest report from April 2022, the IPCC warns fossil fuel investors that gas and oil assets will become stranded likely by mid-century if global warming is not limited to 2°C or below.<sup>208</sup> In the United States, a concerning amount of the market value of gas utilities is tied to assets whose costs may not be recoverable.
- 6. Current regulatory structures and utility business models encourage gas utilities to overinvest in pipeline replacement and underinvest in detecting and repairing leaks.** As a result, utilities are locking in long-lived gas-powered assets that delay the energy transition to renewables: over the past decade, annual gas industry capital spending on gas infrastructure roughly tripled to \$21 billion. Current regulations rewarding pipe replacement rather than encouraging repair reinforce a problematic utility business model that places new gas infrastructure at the core of its profitability. Instead, clear incentives need to be created for gas utilities to successfully repair leaks and develop procedures for verifying and monitoring repairs. The recently proposed PHMSA regulations on leak detection and repair would help redress this imbalance and have the potential to bring a sea change to how many gas utilities currently conduct leak detection, resulting in significant new training, oversight, and enforcement.
- 7. Current state regulatory practices for gas utilities are outdated and misaligned with state climate policy and greenhouse gas reduction goals. Regulatory reform must prioritize long-term gas planning that intelligently downsizes the gas system through a managed, phased approach,** moving block by block or in clusters to retrofit and electrify entire neighborhoods or groups of buildings. The alternative is an unmanaged, incremental approach that will be extremely costly because it requires the current gas system to be maintained indefinitely.

208 IPCC, [Climate Change 2022: Mitigation of Climate Change](#), Working Group III contribution to the Sixth Assessment Report of the IPCC, p. 28.

- 8. The energy transition of lower-income and EJ communities should be prioritized.** These populations are at substantial risk of being left behind on an aging, underutilized gas network facing unaffordable increases in gas rates. Ensuring that this critical part of the residential sector has access to clean heating technologies and full building retrofit resources will dramatically reduce energy use and greenhouse gas emissions for the entire building sector, while bringing strong economic, health, and social benefits to communities that have historically shouldered a disproportionate share of the negative impacts of fossil fuels.

## B. Actions to reduce and eliminate downstream methane emissions

This survey of policy approaches to abate methane emissions and launch a managed, phased transition away from gas demonstrates that a simultaneous, two-pronged approach is essential. Action on near-term priority actions is needed to quickly and effectively reduce climate-damaging methane emissions and to drastically limit any new investment in gas pipelines and related assets. At the same time, transformative planning is needed to spearhead a phased transition away from gas consistent with local and state decarbonization mandates and net-zero goals.

### Track 1: Near-term priorities

Near-term priority actions do not require extensive investigation or fact-finding. Their goal is to speed up the abatement of climate-damaging methane emissions. They also have the potential to reduce the amount of unrecovered infrastructure costs within the gas distribution system (that would otherwise become the obligation of ratepayers and be recouped through higher gas rates) and to better align local gas company operations with state climate policies and the emergence of cleaner, more efficient space and water heating technologies and advanced demand management. Near-term actions are less likely to produce large reductions in methane emissions compared to gas decommissioning. However, they are critical for building awareness and creating pressure for transformative, longer-term change that will require greater governmental intervention given the narrowing time frame.

Table 11 summarizes the near-term actions considered in this report. Many of these are leading the way, providing examples to other jurisdictions and agencies. Together they can help to drive the market toward cleaner, safer energy systems for buildings and speed up the adoption of non-emitting, non-combusting appliances and equipment.

<b>Table 11: Near-term priority actions to reduce emissions and curtail gas system</b>	
<b>Action</b>	<b>Policy Goal</b>
<b>USE ACCURATE MEASUREMENTS/ADD SOCIAL COSTS</b>	
<p>Require accurate measurement of methane emissions from gas distribution systems.</p> <p>Set emission and social cost factors according to the best science available to capture methane's full impact.</p>	<p>Incorporate the negative externalities and social costs of both leaked and combusted gas into: policymaking, regulatory decision-making regarding gas utility capital spending, and private-sector investment decisions.</p>
<b>CURTAIN THE GAS SYSTEM</b>	
<p>Sunset accelerated cost recovery programs for pipeline replacement.</p>	<p>Stop wholesale replacement of pipeline infrastructure, thereby reducing further risk of unrecovered costs and stranded assets.</p>
<p>Restrict capex spending on replacement to highest risk pipes.</p> <p>Apply “higher threshold” review criteria to LDC proposals for pipeline replacement.</p>	<p>Allow only limited, strategic use of pipe replacement investments to avoid installing or replacing unnecessary mains, thereby protecting ratepayers and mitigating stranded costs.</p>
<p>Prohibit blending of hydrogen, RNG, and alternative gases into gas distribution system.</p>	<p>Correct gas utility focus on alternative gases as a decarbonization solution.</p>
<p>Require gas utilities to evaluate and consider non-gas pipeline alternatives (NPAs) to pipeline replacement, including pipeline retirement, beneficial electrification, and thermal energy networks.</p> <p>Require infrastructure spending assessments to include benefit/cost, bill impact, and lifecycle emissions analyses.</p>	<p>Allow for the adoption of NPAs that meet reliability needs without new gas infrastructure investments.</p>
<b>REDUCE GAS END USE</b>	
<p>Prevent gas connections for new construction and major renovations.</p>	<p>Lower new demand for gas.</p>
<p>Adopt enhanced building performance standards.</p>	<p>Encourage electrification and energy efficiency upgrades to building envelopes.</p>
<p>Adopt enhanced equipment performance standards.</p>	<p>Enhance public health by protecting households from indoor and outdoor air pollution caused by the combustion of gas used for heating, cooking, etc.</p>
<b>EMPHASIZE REPAIRS NOT REPLACEMENT</b>	
<p>Require the use of advanced leak detection and repair.</p> <p>Create protocols to verify and monitor repairs to ensure they are successful.</p>	<p>Redirect gas utilities away from costly spending on new pipeline to more cost-effective repairs that extend the life of pipes so as to promote safety and manage pipeline that can be slated for decommissioning.</p>
<p>Implement super-emitter gas leak identification and repair programs.</p>	<p>Eliminate the most climate-damaging gas leaks to realize immediate, large reductions in distribution system emissions.</p>
<b>ADOPT METHANE REDUCTION PROGRAMS &amp; EMISSION TAXES</b>	
<p>Use accurate emission factors to create aggressive, enforceable multi-year program targets for emission reductions by gas utilities.</p>	<p>Strengthen requirements for gas utilities to reduce methane emissions from their operations.</p>
<p>Adopt methane taxes or pricing tied to social cost of methane emissions.</p>	<p>Require economic and financial decision-making to price in social costs of methane emissions and gas combustion.</p>

## Track 2: Gas system transition planning

Longer-term gas planning processes and rulemaking need to run parallel to near-term action. States and cities need to start now to provide for a managed, phased transition off of gas. Cutting methane emissions at the level and rate required will involve several simultaneous, aggressive efforts: electrifying energy end use, reducing energy demand through efficiency measures, and decarbonizing the electrical grid.

### To accomplish this transformative change, gas utility planning and utility regulation must:

- » Be brought into alignment with state and local climate goals
- » Incorporate accurate measurements of methane emissions and their damages into demand and supply forecasts projections that realistically account for declining gas sales and an increasingly contracting customer base
- » Create a strategic path for trimming back existing gas infrastructure or transitioning it to thermal energy networks
- » Ensure that customers have equitable access to clean space and water heating technologies that are safe, adequate, and reliable.

Table 12 summarizes key building blocks for the planning processes and rulemaking necessary for transitioning the gas distribution system.

Table 12: Longer-term actions for transitioning off gas	
Action	Policy Goal
<b>PRIORITIZE ENERGY TRANSITION FOR LOWER-INCOME &amp; ENVIRONMENTAL JUSTICE COMMUNITIES</b>	
Set 2030 goals to decarbonize low-income and EJ homes.	Capture the large potential energy and emissions savings of the low-income housing sector and deliver substantial economic, health, and social benefits.
Blend state and federal funding to create whole-home retrofit and electrification programs that work through unified, “one-stop-shop” platforms.	Capture the large potential energy and emissions savings of the low-income housing sector and deliver substantial economic, health, and social benefits.
Shift incentives to promote electrification, whole-home/building retrofits, and fuel switching from gas to electricity.  Reform utility energy efficiency programs to prevent inequities and regressive outcomes, whereby benefits disproportionately accrue to higher-income households.	Align ratepayer-funded energy efficiency programs with state building decarbonization and electrification goals rather than simply supporting energy efficiency.  Ensure that low-income and EJ ratepayers have equal access to utility efficiency programs.



HALT EXPANSION OF THE GAS SYSTEM	
End line extension allowances.	Halt further expansion of the gas system to limit the lock-in of carbon-based infrastructure assets and reduce potential asset stranding.
Dismantle barriers in utility energy efficiency programs to fuel-switching, including eliminating subsidies for purchasing gas furnaces and appliances.	Leverage state and utility energy efficiency programs to promote fuel-switching in buildings from gas to electric space and water heating plus other household appliances.
CREATE A MANAGED DOWNSIZING OF THE GAS SYSTEM	
Establish long-term gas planning proceedings with stakeholder processes.  Require that rate cases and dockets for capital spending and demand/supply forecasting integrate long-term planning findings and decisions.	Create comprehensive, coordinated state-level plans for a strategic decommissioning and orderly downsizing of the gas system that avoids uncoordinated transitions requiring high-cost maintenance of the gas system.
Develop selection criteria for retiring or transitioning gas lines that consider community characteristics such as energy burden and EJ criteria.  Target successive areas of pipeline to be retired or transitioned starting with highest benefit locations.  Coordinate and integrate zonal retrofit and electrification planning.	Create rapid, scalable, simultaneous decommissioning and electrification pathways and plans that rely on a neighborhood street-segment approach.
Redirect savings created by avoided pipeline replacement to non-emitting, non-combusting solutions such as thermal energy networks.	Encourage proactive investment in energy transition assets that support electrification and do not involve combustion.
Reform retail electric rates to encourage takeup of electric appliances and equipment.	Encourage electrification with lower volumetric charges, for example for customers adopting electric vehicles and heat pumps.

## C. Concluding remarks

Governments must act to ensure that aggressive near-term and longer-term actions to reduce methane emissions and gas use are taken simultaneously. Decisive leadership to reign in the gas industry and revise outmoded utility regulation must accomplish both at once. As one journalist recently commented, “we should not expect the fossil fuel industry to lead us out of a crisis caused by fossil fuels. Only governments have the power to cut demand for these fuels, and their job has barely started.”<sup>209</sup>

Even though strong economic forces are aligning for change, utilities remain sheltered from the upheavals of the energy transition because regulators remove market risk by continuing to approve:

- » Gas-related capital expenditures designed to perpetuate the entire distribution system and its related transmission and storage facilities.
- » Utility requests for higher delivery charges in rate cases that assume electrification and customer departures are not occurring.

For each type of proceeding—rate case and capital spending—utilities and regulators adhere to rigidly defined sets of permissible issues. This severely limits information about the energy transition from being carefully vetted and prevents long-term planning from happening effectively or at all.

The heavily siloed and constrained nature of regulatory proceedings aside, utilities will continue to grow their gas systems and underlying rate bases as long as regulatory commissions continue to provide them with acceptable rates of return. As it stands today, the sheltered, conventional utility business model provides reliable returns to shareholders, and the larger fossil fuel industry for the most part chooses neither to invest its recent unprecedented profits in transition assets, such as renewables, nor to take decisive steps to cut methane emissions from its supply chain.<sup>210</sup>

Ambitious, science-based climate policy and progressive regulation can create the clear market signals needed by consumers, retailers, and manufacturers for the phase-down of gas. Regulators must step up to their critical gatekeeping role for the energy transition by requiring and overseeing an orderly transition away from the gas system. The essential services provided by public utilities are, after all, about the public good. As demonstrated in this report, countless individuals and organizations across the country are engaged in local, municipal, and state action to reduce and eliminate methane emissions. They are ready to scale up and fully realize the clean energy future that the world urgently needs.

209 Piliita Clark, “[The fossil fuel industry will not lead us out of the climate crisis.](#)” The Financial Times (July 19, 2023).

210 Christiana Figueres, “[I thought fossil fuel firms could change. I was wrong.](#)” Aljazeera (July 6, 2023).