REGULATORY SOLUTIONS FOR BUILDING DECARBONIZATION:

TOOLS FOR COMMISSIONS AND OTHER GOVERNMENT AGENCIES

BY SHERRI BILLIMORIA AND MIKE HENCHEN

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ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. The organization has offices in Basalt and Boulder, Colorado; New York City; the San Francisco Bay Area; Washington, D.C.; and Beijing.

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EXECUTIVE SUMMARY

Utilities, their regulators, and state policymakers together have an opportunity to transform American homes and businesses to run on clean energy, eliminating the fossil fuels that drive climate change and worsen air pollution. Modern clean energy technologies like electric heat pumps, especially when paired with efficient buildings, offer the prospect of eliminating emissions while improving comfort, helping integrate renewable energy, and making energy more affordable. And as plans for economic recovery unfold following the COVID-19 pandemic, energy upgrades in buildings can be an important tool for job creation and economic development in communities across the country.

Fossil fuels burned in US buildings contribute 600 million metric tons of carbon dioxide emissions each year, most of it from gas used to heat space and water. Building emissions represent a significant portion of overall emissions, and they have not been declining. Now, with the growing urgency to address climate change and reduce air pollution, public utilities commissions (PUCs)[i] across the country can take crucial steps to support cleaner technologies and phase out these emissions.

The old model of utility regulation is not conducive to an all-electric future. For instance, modern electric heat pumps can provide heat without emissions, but most utility efficiency programs and policies are not well designed to support customers switching from one fuel (gas, propane, or oil) to another (electricity). Electric rate designs traditionally focused on conserving electricity may dissuade customers from going electric. And standard financial approaches to new gas infrastructure, such as spreading these costs over decades, are no longer consistent with the need to quickly eliminate fossil fuel consumption.

The scope of change needed is broad. This report provides a framework for the comprehensive regulatory reforms required to transition to clean energy in the US building sector, along with more than 40 specific recommendations for action. Most of these recommendations are framed in light of the need to decarbonize buildings, but they also offer additional benefits including reduced air pollution and improved health, energy affordability, and improved equity.

This report focuses on electrification as the central decarbonization solution: replacing gas appliances with efficient electric alternatives. Alternative fuels such as "renewable natural gas" (RNG)—for example biomethane, synthetic gas, and hydrogen—should be evaluated by regulators in light of their high costs, limited availability, and risks of continued health and environmental impacts.

The framework is based on 10 change strategies, as depicted in Exhibit 1. Three categories describe the holistic strategies that are broadly needed to support this transformation, including a focus on equity and inclusion that is critical for the success of all other strategies.

- **Holistic Approaches to Decarbonization:** These strategies start with addressing the equity impacts of the transition. Regulatory reforms, no matter how well-meaning, will be less effective in achieving social goals if they fail to incorporate community-led decision-making and ensure an equitable distribution of the benefits of a transition to emissions-free buildings. This section also explores the intersections of utility regulation with other agencies, the need for clarity on alternative fuels to natural gas, and plans for the future workforce needed to deliver energy solutions to customers.

[i] Throughout this paper, we use the term "PUC" as shorthand to refer to state agencies that regulate monopoly utilities, including public utilities commissions, public service commissions, utility transportation commissions, etc.

- **Near-Term Market Opportunities:** These strategies focus on transforming today's programs, markets, and supply chains and updating the rules and rates that govern how customers receive and pay for energy and services.
- **Managing the Transition:** These strategies explore the changes needed for a long-term transition away from widespread gas use in buildings, including complex issues around the future of gas utilities and how to wind down gas infrastructure spending.

Exhibit 1:
Ten Key Strategies to Support Building Decarbonization

TOP RECOMMENDATIONS

1. **Set a clear direction for aligning the utility system with the climate imperative.** Utility regulators have a critical role to play in the future of energy use across the country and the success or failure of climate policy. Even as 23 states have established greenhouse gas reduction targets, building emissions have not declined. Utility regulators can clarify their own role in achieving these climate targets—or policymakers can make that role clear—and establish a vision for the future of the utility system that is consistent with those goals.

Then, whether in dedicated decarbonization proceedings or in traditional rate cases, regulators can consistently apply a decarbonization lens to key decisions and accelerate the transition to emissions-free buildings. Only with a clear long-term vision about the future of utilities and the energy they deliver can the energy system transform on the scale needed.

2. **Build the market for new clean energy solutions in buildings.** For new solutions like heat pumps to progress at speed, market transformation is necessary in states with little existing market for these technologies. Experience from Vermont and New York has shown that midstream incentives—targeted to wholesale distributors or contractors rather than individual customers—have been successful in establishing nascent heat pump markets when combined with supply chain engagement.[1]

Effective customer programs will also bundle energy efficiency and demand response, incorporate on-bill financing to make energy upgrades affordable, and ensure participation of low-income customers through targeted spending and community engagement. Additionally, PUCs can align existing energy efficiency policies with decarbonization, by updating energy efficiency resource standards based on total energy or emissions, and by updating how cost-effectiveness is measured and used to ensure it supports policy goals. And where outright prohibitions on supporting fuel-switching exist, these restrictions can be replaced with guidelines to ensure fuel-switching is beneficial for customers and the environment.

3. Stop expanding the gas delivery system.

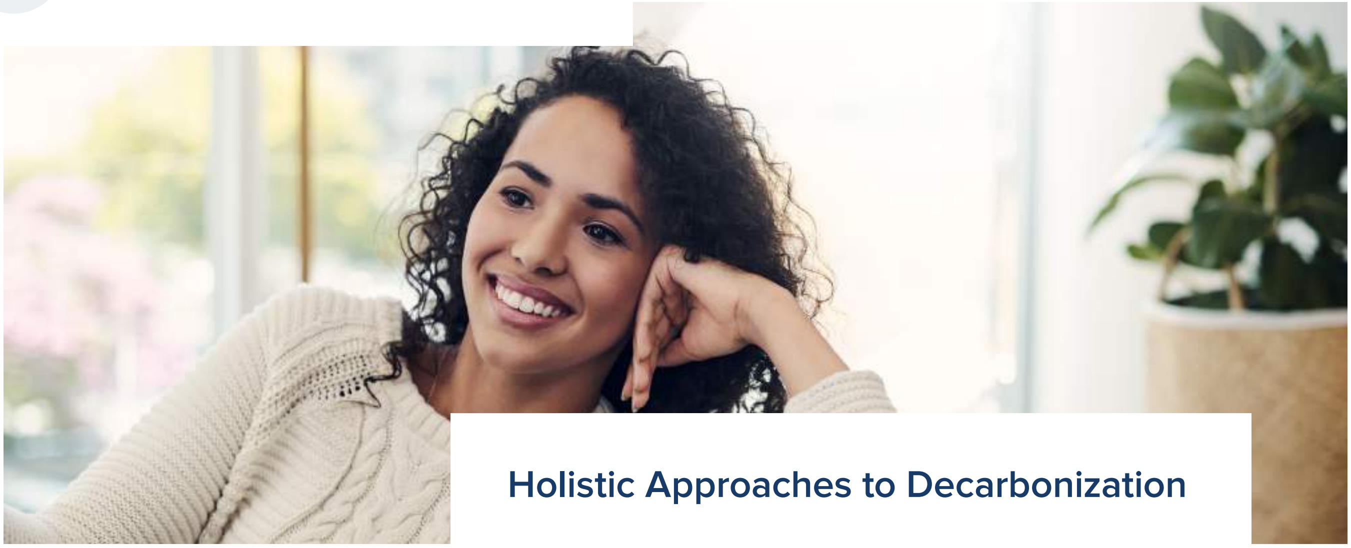
The gas delivery system is expanding nearly 10,000 miles each year, bringing gas to hundreds of thousands of new buildings.[2] This infrastructure is typically financed through utilities' rate base accounting, on the expectation that customers will pay it off through continued gas bills for decades to come.

Continued spending on fossil fuel infrastructure—and the expectation that customers will continue paying gas bills at today's levels to pay it off—are incompatible with the need to eliminate fossil fuel combustion to address climate change. Aside from the direct climate risk, this creates financial risk for ratepayers who will be holding the bill for infrastructure that becomes underutilized in the future. Regulators can reform rules that govern line extensions (i.e., bringing gas to new buildings) and increase the PUC role in evaluating any new gas capacity expansions like pipelines. New policies can require evaluation of non-pipes alternatives and minimize the financial burden on ratepayers to fund new infrastructure.

4. Create a path to wind down gas systems safely and affordably.

To reach the targets for carbon neutrality that states and cities are now adopting, direct building emissions will have to fall dramatically, as will gas consumption. As gas use diminishes, it will be economically beneficial to decommission sections of the natural gas system. Maintaining the entire system to serve minimal customer loads would challenge affordability and potentially shift costs substantially from low-usage (e.g., cooking only) customers to others less able to electrify.

Regulators can work with utilities to develop targeted electrification plans in order to retire segments of the gas system and manage costs during a gas-to-electric transition. PUCs will need to establish new pathways for doing this, which may include targeted incentives and local deadlines for discontinuing gas service.



Holistic Approaches to Decarbonization

01 Focus on Equity and Inclusion

- Run inclusive public processes
- Enable community-led decision-making
- Include dedicated funding and carve-outs to support low- and moderate-income (LMI) customers
- Adapt existing LMI programs to support customers transitioning to electric equipment

02 Align Decarbonization Regulatory Work across State and Local Agencies

- Clarify the PUC role in decarbonization to ensure gas systems are addressed in climate solutions
- Coordinate with state agencies with complementary roles
- Coordinate state energy regulation with city action

03 Establish Clear Guidelines for Alternative Fuels

- Develop rigorous standards for carbon accounting and impacts on feedstock sources
- Understand supply and deconflict different uses for alternative fuels
- Evaluate alternative fuel tariff programs
- Establish technical standards for hydrogen blending
- Establish procurement requirements for gas that require suppliers to be certified according to a methane emissions standard

04 Plan for Workforce Development

- Plan a just transition for current gas employees
- Develop the new heat pump workforce

Near-Term Market Opportunities

05 Optimize Customer and Market Offerings

- Target programs and spending equitably to reach all customers
- Support market transformation with upstream and midstream incentives and training
- Design effective customer-facing programs
- Enable on-bill financing for electrification
- Bundle efficiency and electrification upgrades
- Expand demand response programs for all-electric buildings
- Support pilot projects that can scale quickly

06 Align Efficiency Policies with Decarbonization

- Update energy efficiency resource standards (EERS) to be based on total energy across fuels or greenhouse gas emissions
- Reform cost-effectiveness criteria and evaluate how they support policy goals such as building decarbonization
- Incorporate a social cost of carbon in cost tests
- Account for infrastructure costs that can be avoided with all-electric buildings
- Remove prohibitions on fuel switching
- Phase out utility incentives for gas appliances

07 Update Electricity Rate Designs

- Consider equity impacts of electric rate changes
- Eliminate or reduce inclining block electric rates
- Expand time-varying electricity pricing with significant peak-to-off-peak price ratios
- Reevaluate the use of fixed charges to offset volumetric electric rates
- Limit demand charges in electric rates
- Consider new electric rate concepts, such as subscription models
- Reevaluate cost allocation and depreciation schedules for gas rates in a changing system

Managing the Transition

08 Expand Energy System Planning

- Plan for electric grid impacts of electrification
- Enhance energy system resilience along with electrification
- Increase the PUC role in reviewing gas capacity expansions like new pipelines
- Develop plans for deliberate electrification and retirement of sections of the gas delivery system

09 Modernize Utility Business Models

- Identify pathways for gas utilities in a decarbonized future
- Expand revenue decoupling
- Introduce performance incentive mechanisms
- Develop shared savings mechanisms
- Reform operating expense and capital expense accounting

10 Manage Infrastructure and Stranded Asset Risk

- Update gas line extension allowances
- Require evaluation of non-pipes solutions
- Establish a process to retire shared assets
- Create a gas system transition fund

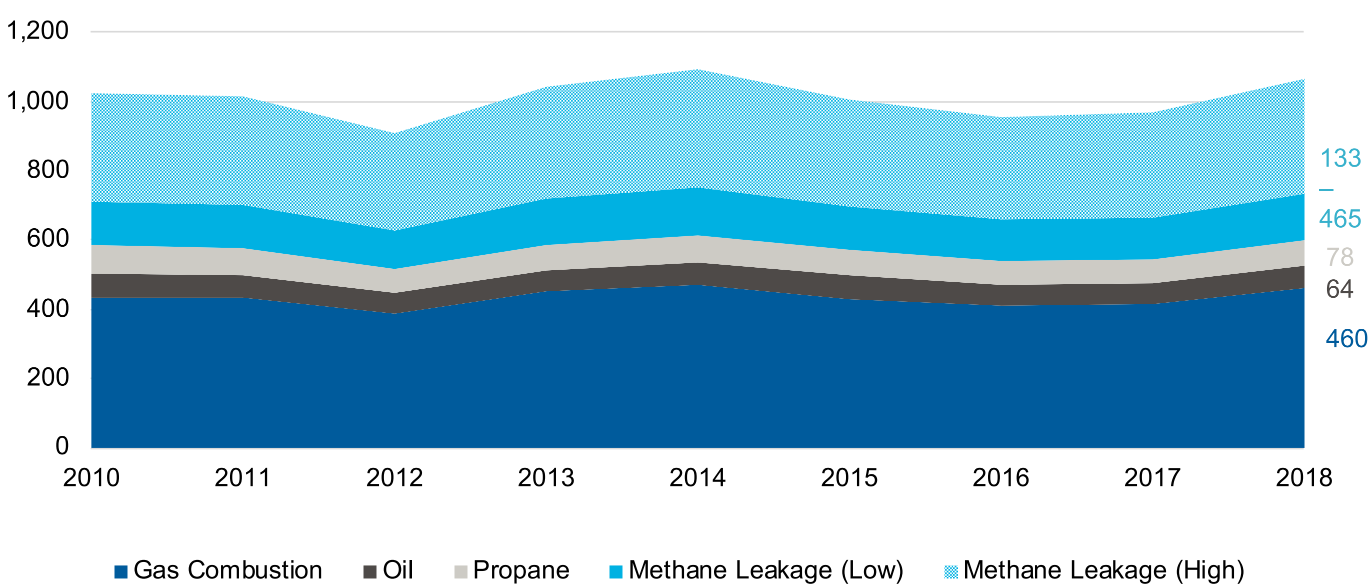
INTRODUCTION

To meet the imperative of curbing climate change and restoring clean and healthy air to our communities, it is critical that policymakers act to eliminate greenhouse gas (GHG) emissions from the building sector. In the United States, fossil fuels burned in residential and commercial buildings account for at least 600 million metric tons of CO_2 equivalent emissions per year; this number increases by hundreds of millions of metric tons when considering varying estimates of methane leakage from oil and gas supply chains.[3]

For instance, estimates of leakage totaling 2.2 percent of all gas consumption and calculating emissions impacts over 100 years add 133 million metric tons of CO_2 equivalent emissions per year. Higher estimates of up to 3.9 percent leakage, calculating the emissions impacts over just 20 years, add up to 465 million metric tons.

Switching from fossil fuel-fired devices to efficient electric devices powered by clean electricity is crucial to reducing and eliminating building emissions. While carbon emissions from the electric grid have fallen by a third since 2007,[4] emissions from fossil fuels in buildings have increased. This stands in stark contrast with scenarios that keep the Earth under target levels of warming, which require emissions to decline by roughly half by 2030 and to net zero by 2050.[5]

EXHIBIT 2:
Direct Building Emissions Have Remained Flat over the Past Decade



Note: “Low” leakage scenario represents 2.2% leakage at 100-year GWP; “High” represents 3.9% leakage at 20-year GWP.
Sources: EIA 2018, Rhodium Group 2019, RMI analysis

Burning gas in our buildings also has serious health impacts, particularly on the respiratory system, and children are especially susceptible. A meta-analysis of health studies examining the link between gas cooking and children's health found that children living in homes with gas stoves have a 42 percent increased risk of experiencing asthma symptoms and a 24 percent increased risk of being diagnosed with asthma by a doctor.[6] Eliminating gas combustion in buildings can achieve significant public health benefits.

As a growing number of states and cities set aggressive climate goals, building decarbonization becomes increasingly important. This is prompting policymakers to consider the respective roles of building electrification, alternative fuels, and energy efficiency in the overall strategy to achieve these goals.

While proposals to replace fossil gas with biomethane or synthetic gas alternatives appear to offer simplicity in maintaining existing appliances and utility systems, these options do nothing to address the human health impacts of gas combustion, and the limited supply of affordable biomethane makes these options very expensive to scale.

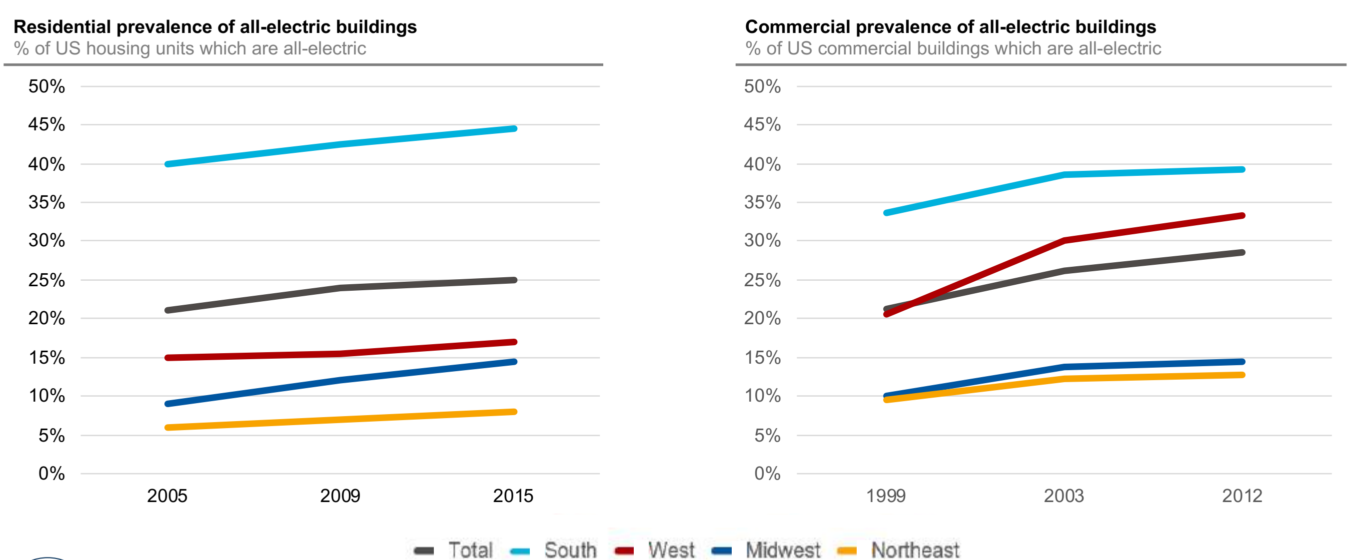
Studies across varied geographies, including California and New Jersey,[7] show that building electrification is the least-cost pathway to decarbonization.

It is no surprise, then, that cities and states alike are beginning to directly address electrification. From electrification-focused legislation in California to heat pump deployment goals in Maine, there is a clear trend toward electrification. Once new gas infrastructure is built, it is typically expected to have a long service life, so there is a clear imperative to plan today in order to reduce emissions from fossil fuel use in buildings, and to limit the gas distribution system.

Further, there is a growing natural market trend toward electrification. Public utilities commissions (PUCs) and other state agencies have an important role to respond to bigger trends, both market and policy, including preparing for likely policy change to manage future risk.

This paper provides an overarching framework of key opportunities for state regulators to support building decarbonization. Additional resources, including more detailed white papers and recommendations from other organizations, are available on RMI's website at **rmi.org/insight/regulatory-solutions-for-building-decarbonization**.

EXHIBIT 3:
A Growing Share of US Buildings Are All-Electric



Source: EIA RECS and CBECS

How Does Electrification Reduce Carbon Emissions?

EXHIBIT 4:
The US Electricity System Is Reducing Carbon Emissions Substantially, While Emissions from Fuel Use in Buildings is Flat to Slightly Increasing

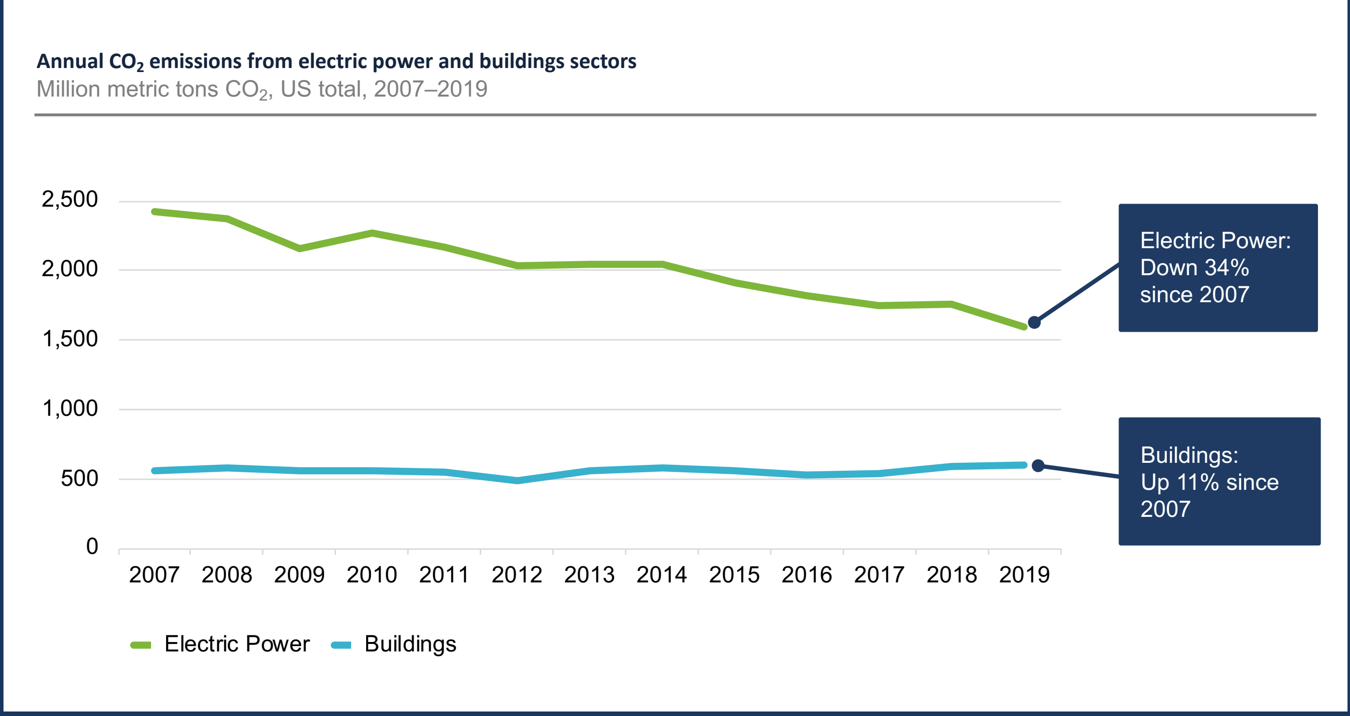
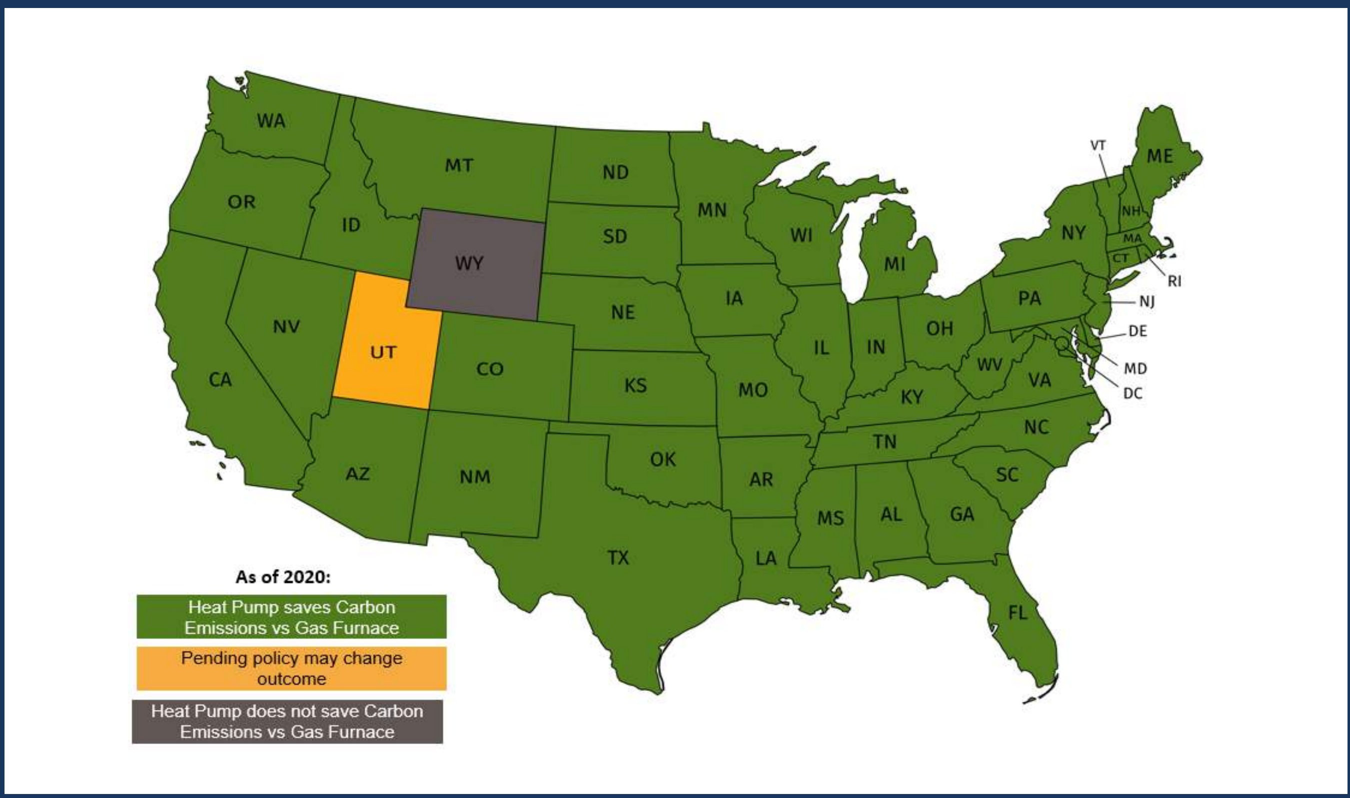


EXHIBIT 5:
Lifetime Emissions Impact by State—Heat Pumps vs. Gas Furnace (Continental United States)



Steep declines in coal power generation mean that modern electric heat pumps have become lower carbon options to gas heating. This is already true in most of the country today, and since heating equipment will likely operate for 15 years or longer, as the US electric system continues to get cleaner, the lifetime emissions of a heat pump installed today will almost certainly be lower than gas alternatives across the country, excepting any isolated pockets where coal continues to dominate into the 2030s. Even when electricity is generated by natural gas, the high efficiencies of heat pumps still produce less carbon than gas appliances or electric resistance devices.

Historically, heat pumps were primarily used in mild climates and did not function well in colder temperatures. New technologies such as inverter-driven heat pumps and vapor injection have changed this dramatically. The Northeast Energy Efficiency Partnership maintains a database of cold climate heat pumps,[8] listing hundreds of devices that operate efficiently at 5°F, with some operating as cold as -15°F. Ground source heat pumps, while often more expensive, can provide extremely efficient heat at very cold temperatures.

WHY REGULATORY AND POLICY CHANGES ARE NEEDED

To decarbonize buildings at scale, substantial regulatory change will be required, along with supportive policy from state legislatures. Scaling building electrification must carefully balance speed, equity, and heating reliability. State regulators have a clear opportunity to lead by removing barriers to electrification while managing the risks. Regulatory change is urgently needed for several reasons:

- **Gas utility business models are based on building out long-lived fossil fuel infrastructure**. Traditional cost-of-service regulation means that utilities make money by investing in capital projects with a long lifetime. The resulting physical infrastructure requires ongoing investments to maintain and operate safely and, eventually, to be decommissioned. Without a clear plan for alternatives and shifts in regulation to enable them, ratepayers will be paying for fossil fuel infrastructure for decades to come; climate goals require drastically reducing gas usage long before the end of the useful life of new investments.

- **Regulation and policy have always been intertwined, and they require a refresh**. In the past, policy explicitly preferred gas to electric heating, as the former was cheaper and more efficient. In parallel, policy evolved to place restrictions on fuel switching and complicated cost tests for efficiency programs. As technologies, grid mixes, and efficiencies have changed, electrification is emerging as the least-cost pathway to building decarbonization, and policy must adapt accordingly. Given that 23 states and the District of Columbia have explicit greenhouse gas reduction targets,[9] PUCs need to adapt in order to successfully implement and regulate this policy outcome.

- Given today's facts and priorities, **regulation that explicitly or implicitly prevents electrification must be altered.** California has updated the "three-prong test," which effectively prevented using ratepayer funds for building electrification. Many other states still have prohibitions on fuel switching, and these must be updated.

- With electrification of buildings, **the grid impacts of increased load must be carefully managed.** While reliability and safety remain paramount, there is a balance to ensure that utility spending on upgrades does not result in negative bill impacts for all electric customers, especially those who can least afford it.

- To meet climate goals, **the gas utility and the gas transmission and distribution system must fundamentally change.** Without leadership and a managed plan, this transition will be more expensive and inequitable, with the cost of maintaining the gas distribution system falling on customers, likely low-income customers and renters, who are less able to electrify. If regulators and policymakers can proactively plan for a managed transition, the move toward decarbonizing buildings can be more equitable and affordable.

Multiple states have begun to take action toward these goals. For example, SB 1477 in California directed the CPUC to establish two building electrification programs; the CPUC recently approved both projects, allocating $200 million to electrification efforts targeting new construction, especially low-income housing, and market transformation.

In Colorado, recent legislation directs the PUC to include the social cost of carbon in decision-making, including for electrification. Maine and New York both have aggressive heat pump targets.[10] At least 30 cities have passed ordinances preferring or requiring all-electric new construction.[11] As building decarbonization increases in importance, all states will need to develop strategies to support these efforts.

FRAMEWORK FOR BUILDING DECARBONIZATION

Regulators and state policymakers should pursue reform along ten key strategies to support building decarbonization, with a central focus on equity and inclusion throughout. This framework provides an overview of the wide range of solutions regulators might pursue in support of building decarbonization, ranging from incentives for individual appliances to considering the need for a managed transition of the gas distribution system.

Some of these solutions can and should be implemented immediately; others should be incorporated into plans for the future. Regulators will need to balance many priorities and considerations as they consider these options; some of these solutions will require policy change or policy coordination with other state agencies. Coordination and a clear vision of the path to building decarbonization will be crucial to success.

EXHIBIT 6:
Ten Key Strategies to Support Building Decarbonization

1. FOCUS ON EQUITY AND INCLUSION

Equity and inclusion must be considered throughout all the potential solutions in this framework; low-and-moderate income (LMI) customers and disadvantaged communities (DAC) cannot be an afterthought. Without proactive attention and action, there is a real risk that these communities will not only miss out on the potential benefits of building electrification, but that they will be left to pay for the rising costs of a gas distribution system as wealthy customers electrify and stop paying gas bills.

Absent active planning, low-income customers are most likely to be unable to afford to electrify their homes, or to live in rental housing without the ability to control whether to electrify. Any complete transition away from fossil fuels in buildings must meaningfully include LMI and DAC customers. In order to meet climate goals, electrification cannot be only for the wealthy. Specific recommendations follow.

Run inclusive public processes. LMI and DAC community advocates have not often been part of energy policymaking, and as a result their interests have suffered. Therefore, as regulatory and policy decisions are made, these non-traditional stakeholders—for example, community-based organizations, low-income advocates, and environmental justice groups—must be meaningfully included throughout the process.

Meaningful inclusion may include new types of outreach and more collaborative processes, as well as active education. Rethinking regulatory processes might include taking the time to do robust stakeholder outreach, choosing formats other than traditional written comments and hearings, and working with a neutral facilitator. Compensating intervenors for their participation, as California does, can ensure that organizations with fewer resources than utilities are able to meaningfully participate in proceedings. For more on inclusive regulatory processes, see RMI's 2019 report, ***Process for Purpose***.

The San Joaquin Disadvantaged Communities Pilot Projects

The efforts in California's San Joaquin Valley are a strong example of what successful community engagement can look like. The San Joaquin Disadvantaged Communities Pilot Projects[12] allowed communities to work together to determine the best solutions to overcome their challenges. These San Joaquin Valley communities have not been served by gas infrastructure and instead heat their homes with propane or wood, with serious cost, health, and climate impacts.

By partnering with trusted local organizations and doing deep community engagement, Commissioner Martha Guzman Aceves and her team ran a proceeding resulting in electrification pilots in 11 communities. Community decision-making made clear that the priorities of the residents of these communities revolved around energy affordability, health, and safety, as well as workforce development, rather than technology or renewable energy. Specific considerations, including extended warranties, workforce training and education, and co-benefits like access to home broadband, were included in the decision as a direct result of community input.

Enable community-led decision-making. Rather than state agencies or utilities determining what the best solutions are for specific communities, where possible, communities should have the ability to assess their own needs and design the solutions appropriate to them.

For example, the Netherlands is pioneering another strong example of community-led decision making.[13] The Netherlands has a goal of eliminating natural gas usage by 2050, while today 95 percent of buildings are heated by gas. The national plan will establish 30 regions and ask each to develop regional energy strategies. Within each region, stakeholders ranging from municipalities to business associations to citizen groups will determine through democratic processes their own local plans for decarbonizing the building stock.

In the United States, community-led decision-making should include preserving the ability of individual cities to commit to all-electric buildings with stretch codes or other policies, as 30 California cities have already done.[14]

Include dedicated funding and carve-outs to support low- and moderate-income (LMI) customers. LMI-focused electrification initiatives must have adequate and predictable funding. Broad electrification programs can include specific funding carve-outs for LMI customers (e.g., that 75 percent of allocated funding is set aside for LMI customers), or allocate a portion of outcome targets (e.g., that 40,000 heat pumps must be deployed to LMI customers). The California PUC's new BUILD program encouraging new all-electric construction will require that no less than 75 percent of funding be directed to low-income housing and includes additional technical assistance and utility bill protection for these customers.[15]

Adapt existing LMI programs to support customers transitioning to electric equipment. Some existing bill assistance programs have predetermined support levels for electric and gas bills and should be reformed to provide sufficient support for customers as they substitute gas equipment with electric appliances, even if it is not whole-house electrification. Other programs such as the federally funded Low-Income Home Energy Assistance Program (LIHEAP) and Weatherization Assistance Program (WAP) can be adapted to fund electrification retrofits for customers, as is happening in Maine.[16]

Greenlining Institute's Equitable Building Electrification

Greenlining Institute's ***Equitable Building Electrification***[17] report highlights five key steps for aligning building electrification efforts with equity goals and provides a more detailed discussion of how to implement these principles in practice:

1. Assess the Communities' Needs
2. Establish Community-Led Decision-Making
3. Develop Metrics and a Plan for Tracking
4. Ensure Funding and Program Leveraging
5. Improve Outcomes

2. ALIGN DECARBONIZATION REGULATORY WORK ACROSS STATE AND LOCAL AGENCIES

As state- and city-level climate action intensifies around the country, so will the opportunity for greater coordination between PUCs and other state agencies, legislatures, and cities. The scale of transformation needed to eliminate building emissions will require a cohesive strategy across government. To maximize progress in meeting shared objectives, PUCs and other government bodies can take the following steps:

- **Clarify the PUC role in decarbonization to ensure gas systems are addressed in climate solutions.** Commissions with a clear mandate to support state climate policy have greater leeway to implement creative and complex solutions, including those laid out in this report. Where such a mandate is not already clear, legislators or governors can provide it through new laws and executive orders, and PUCs can clearly call out gaps in their authority that impede progress.

  In other words, if the state has clear climate law, as is now the case in nearly two dozen states, it should be clear that the utility commission is not solely an economic regulator, but has an obligation and authority to take environmental concerns into account while making decisions.

  And if the PUC finds that specific laws prevent them from taking the actions needed for climate progress, they should clearly communicate those legal barriers to legislatures. For example, following an investigative public process to explore trends, technologies, and policy drivers in the electric sector, the Oregon PUC requested the legislature grant the PUC expanded authority to make decisions around climate change and equity.[18]

- **Coordinate with state agencies with complementary roles.** While PUCs play a significant role in regulating utilities, state decarbonization efforts require this work to happen in concert with the policy and regulation happening at other state agencies, including those responsible for building codes, air quality, health, and environmental conservation.

  For example, the state agencies responsible for meeting climate targets in California and Colorado are the California Air Resource Board (CARB) and the Air Quality Control Commission (AQCC), respectively. Yet successful decarbonization strategy will also require improved building energy codes (in California, regulated by the California Energy Commission) as well as updated utility regulation, falling under the purview of the PUC. For building decarbonization to progress quickly, these different agencies, with different but overlapping authorities, will have to work together to develop an aligned set of standards, incentives, and regulations that support the rapid decarbonization of buildings.

  Given the serious indoor air quality and health concerns from burning gas in homes, there may be an important role for health agencies to support building electrification. State economic development departments have a valuable role to play in supporting workforce development for those deploying new heat pump solutions.

State-level building codes can also play a significant role in building decarbonization. We are already seeing the impact of local building codes through codes that prefer or require all-electric new construction, along with supporting measures like efficiency and demand response. Additionally, as heat pump technology advances, states can support the sale of heat pumps that use low global warming potential (GWP) refrigerants.

- **Coordinate state energy regulation with city action.** Finally, states will have to be attentive and responsive to the decarbonization efforts happening at the city level. The City of Berkeley, California, was the first to ban natural gas in new construction.[19] In July 2019, the Berkeley City Council voted to require all new single-family homes and small apartment buildings to have electric infrastructure rather than natural gas—a decision supported by the local investor-owned dual-fuel utility, Pacific Gas & Electric.

  Since then, 30 cities in California and one in Massachusetts have passed measures that prefer all-electric construction.[20] San Jose, the tenth-largest city in the country, requires all new buildings to be all-electric. Cities elsewhere have taken other approaches, including offering incentives for heat pumps, instituting building performance standards,[21] or integrating electrification into home energy advising programs.[22] As these types of city-level electrification efforts grow and spread, states will need to be proactive in responding and offering long-term solutions.

3. ESTABLISH CLEAR GUIDELINES FOR ALTERNATIVE FUELS

Alongside electrification, proposals to decarbonize pipeline fuels have emerged around the country. This approach would entail substituting alternate fuels for the fossil-based natural gas currently distributed through the gas system. These fuels are often described as renewable natural gas. Other fuels may also be supported by policy in some states, including biomass or liquid fuels.

While proponents of these fuels tout the possibility of maintaining existing infrastructure and business models, they have significant limitations. These fuels are challenged by limited potential to scale (in the case of biomethane), limited blending potential with gas (in the case of hydrogen), and high cost and low technical maturity (in the case of synthetic methane). Both biomethane and synthetic methane would also have climate impacts resulting from direct methane leakage.

A variety of studies evaluating the lowest-cost pathways for achieving a 1.5 degree climate-aligned future have concluded that residential and commercial buildings need to be electrified; such studies have focused on varied geographies including California, New Jersey, the Midwestern United States, and the United States at large.[23] To the extent they play a role in a decarbonized economy, these alternative fuels may be more useful in applications that are hard to electrify, like industrial processes or in seasonal balancing of the electricity system, rather than the residential and commercial buildings sector.

Understanding the Different Alternate Fuels

Biomethane, the fuel most often associated with the term “renewable natural gas” or RNG, is methane captured from organic waste sources such as landfills, wastewater, or dairies, and processed to be suitable for injection into gas pipelines. The major limitations of biomethane are its limited supply, competing demands, and high cost. The US Department of Energy’s National Renewable Energy Laboratory has estimated the national potential supply of biomethane at 420 billion cubic feet.[24] Some of this potential supply may be avoided entirely with approaches such as landfill waste diversion. Even if this entire supply were captured, processed, and distributed to buildings, it would only meet 5 percent of today’s demand.

Hydrogen could be blended with natural gas in today’s pipes with minimal infrastructure upgrades, but only to approximately 7 percent blend levels (by energy content).[25] Pure hydrogen could hypothetically be distributed to homes and businesses, but this would require major upgrades or replacements to gas distribution infrastructure and to end-use equipment—gas furnaces, boilers, water heaters, and more in millions of buildings would need to be replaced with devices configured to burn hydrogen.

Synthetic methane can be created in a power-to-gas application that uses the Sabatier reaction to produce methane from hydrogen and carbon dioxide. This process also faces high costs and relies on immature technology such as direct air capture to provide carbon dioxide. This approach still requires producing and distributing methane, so its carbon-free credentials rely on eliminating leaks.

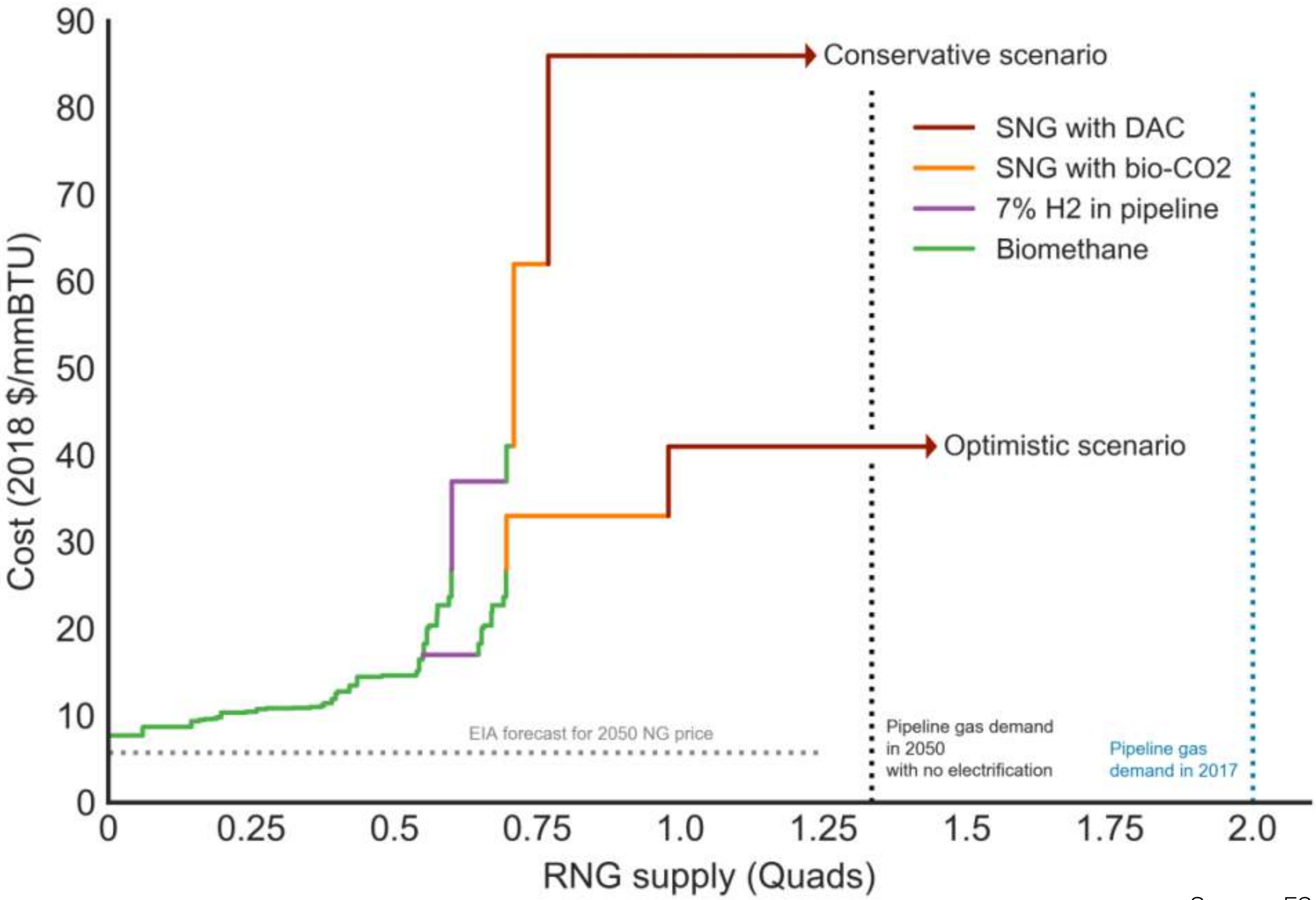
Methane emissions in today's US oil and gas supply chain produce global warming impact comparable to that from combusting the gas itself.[26] In some oil and gas-producing regions, methane emissions are especially high, reaching 3.7 percent of gross gas extraction.[27] Any new supply chain developed to produce and distribute synthetic methane would face similar risk of leakage impacts.

Low-methane emissions gas is gas produced according to a **standard designed to curb methane emissions at the production site**, where over 50 percent of methane emissions occur.[28] While this product is only beginning to become commercially available, it presents an opportunity for natural gas buyers to drive methane reductions at the gas source, in addition to mitigating leaks in their own pipeline networks. Less expensive than alternatives like biomethane and synthetic methane, certified gas is a near-term alternative for conventionally produced gas. However, as is the case for other alternative fuels like biomethane and synthetic methane, the benefits of using certified gas can be undermined if it is distributed via leaky infrastructure.

While these fuels are not widely used today, recent state-level analysis in California and New Jersey has provided insight into their potential role in decarbonizing buildings. The California Energy Commission produced a study, conducted by E3, which evaluated the role of the natural gas system in the state's future and concluded that "building electrification is likely to be a lower-cost, lower-risk long-term strategy compared to renewable natural gas."[29] Supply curve analysis concluded that fully decarbonizing the gas system with RNG would require the use of synthetic gas at costs of $40–$80 per MMBtu, and that "there is insufficient low-cost, sustainable RNG supply to decarbonize the pipeline fully without electrification."

EXHIBIT 7:

California Renewable Natural Gas Technical Potential Supply Curve in 2050, Assuming All Biomass is Directed to Renewable Natural Gas[30]



Source: E3

Likewise, New Jersey's Energy Master Plan, released in early 2020, found that electrification is preferred over retaining gas fuels in buildings because it is both lower cost and more flexible, meaning that electrification allows heating via a number of clean electricity sources while retaining gas fuels means reliance on the few low-carbon gas fuel options, all of which are known to be very expensive.[31]

In order to clarify the role of alternative fuels, state regulators should consider the following actions:

- **Develop rigorous standards for carbon accounting and impacts on feedstock sources**. Currently, there are limited and inconsistent standards to establish whether biomethane or other "renewable natural gas" achieves its carbon reduction goals. Corporate commitments vary in their approach, including a recent claim from Dominion Energy that its gas supply would be carbon neutral if it procures RNG equivalent to just 4 percent of its total volume of gas sales, asserting on their website that "because RNG captures 25 times more greenhouse gas than it releases, that will offset our customer carbon footprint by 100 percent!"[32]

  Such claims, in particular those that rely on offsetting emissions that continue in the gas system with claimed reductions elsewhere in the economy, must be held to rigorous standards that support clean energy and emissions goals. These claims will fall short of carbon neutrality goals if substantial direct emissions of CO_2 remain, and if offset accounting does not guarantee that negative emissions are additional to those that could have occurred through other means.

  Furthermore, carbon-free credentials of biomethane and synthetic methane rely on eliminating leaks. Direct emissions of methane in the US oil and gas supply chain produce a comparable warming effect to the combustion of the gas itself.[33] This risk may be compounded if new markets for biomethane drive expanded production of biomethane feedstocks, for the explicit purpose of methane production. Clear standards should prevent biomethane from these new feedstocks to claim carbon reduction credit. In order to support alternative fuels, PUCs and customers must feel confident that these fuels actually reduce carbon emissions.

- **Understand supply and deconflict different uses for alternative fuels.** The availability of alternative fuels, especially biomethane, is highly limited and has competing uses in other sectors. Given that the supply of alternative fuels will not be sufficient to meet the current natural gas use in buildings, these fuels are likely better suited for hard-to-electrify sectors, including industrial processes, and for electricity generation to balance seasonal mismatches in demand and renewable generation. Regulators should understand the cross-sector impacts of RNG use in buildings and ensure programs are consistent with economy-wide decarbonization plans.

- **Evaluate alternative fuel tariff programs.** Gas utilities have proposed voluntary RNG programs in which customers could opt in to purchase biomethane for their gas supply. Such programs would resemble voluntary renewable electricity programs offered by electric utilities around the country. The Minnesota PUC recently rejected a proposal from Centerpoint Gas for a renewable natural gas program, noting that there was insufficient verification to ensure that the gas would be truly renewable.[34]

  Cost is also a concern with RNG programs. In this case, Centerpoint estimated RNG would cost customers nearly $4.00 per therm,[35] compared with $0.61 per therm charged today for fossil gas, inclusive of delivery charges.[36] Gas utilities are likely to introduce more programs proposing alternative fuels, and it will be imperative for PUCs to establish clear criteria for these programs, including cost and environmental accounting. It will also be critical to ensure any such programs do not limit progress on electrification, which multiple studies have shown must be a major part of a successful decarbonization pathway.

- **Establish technical standards for hydrogen blending.** Renewable hydrogen, blended into the supply of pipeline gas, could reduce the carbon intensity of gas, but is limited by the technical capacity of existing pipes and end-use appliances to accommodate hydrogen.

  Various studies estimate the maximum blend ratio that current infrastructure could accept at anywhere from 5–20 percent by volume[37] (20 percent by volume is equivalent to just 7 percent by energy content).[38] Technical evaluations would be needed on a system-by-system basis to determine the locally appropriate maximum. Blend ratios above these levels would require upgrades to infrastructure and end-use equipment, and the costs of such upgrades would need to be considered carefully, not to mention the practicalities of ensuring all customer-owned equipment is properly upgraded before increasing hydrogen blending.

- **Establish procurement requirements for gas that require suppliers to be certified according to a methane emissions standard.** Even as gas demand declines, regulators have an opportunity to set the bar for the type of gas that enters energy systems in their states. By demanding gas that is produced with a lower methane intensity (methane emissions divided by gas produced), better methane monitoring technology, and best practices to find and repair leaks, regulators can push widescale changes in the upstream oil and gas industry. This offers a significant opportunity for the state to incentivize better actions not only by the utilities within its borders, but also from gas suppliers who may be several states away.

4. PLAN FOR WORKFORCE DEVELOPMENT

As in other sectors of the economy, the transition to a carbon-free buildings sector will both create new employment opportunities (e.g., installing new equipment, performing efficiency upgrades, engineering and manufacturing new technical solutions, expanding electricity generation) and eventually require a managed transition away from employment focused on diminishing fossil fuel use (e.g., engineering and installing gas distribution infrastructure, installing gas appliances, delivering oil and propane to homes and businesses).

State utility regulators have several reasons to ensure thorough planning of these transitions. Transitions will directly affect the workforces of regulated utilities, and planning will improve the lives of affected workers and the communities in which they live. Additionally, successful deployment of heat pump markets requires that workers have the knowledge, skills, and abilities (KSAs) to improve the efficiency of buildings, properly size heat pump replacements, and ensure high quality installation and maintenance. A skilled workforce ensures that bids are accurate and not inflated due to uncertainty or lack of knowledge.

- **Plan a just transition for current gas employees.** California alone has 10,000 workers employed in the gas distribution sector.[39] During a transition away from the current gas distribution system, there will be better and worse pathways for workers, making it crucial to have open planning conversations that include voices from the labor community from the start. Ignoring workforce issues and the voices of organized labor would lead to less robust transition planning and engender serious opposition to building decarbonization efforts.

  With proactive planning, there is time to ensure a just transition for current gas workers. As noted in a recent report from Gridworks about the gas transition in California, there is a need to "keep highly skilled people working until the end, incent the senior workers to retire at the right time, and retrain junior workers."[40] UCLA and Inclusive Economics suggest developing a transition fund for gas worker retention and transition assistance, noting that even a shrinking gas system will require a skilled labor force to maintain safety and repairs.[41]

  In New England, providers of heating oil are planning for a low-carbon future by developing their ability to offer their customers new products and services. The Oil Heat Institute of Rhode Island rebranded itself in 2019 to become the Energy Marketers Association of Rhode Island, and has adopted industry-wide commitments to eliminate greenhouse gas emissions. It has partnered with the state's Office of Energy Resources and Department of Labor and Training to develop the skills and business models to participate in heat pump deployment.[42]

- **Develop the new heat pump workforce.** Second, as the heat pump market grows, there must be a sufficient and well-trained workforce ready to sell and install these devices. Given expected retirement of the current HVAC workforce, over 100,000 new HVAC contractors and workers will be needed by 2022.[43] This creates a strong need to train new workers or upskill existing workers to fill that gap, as well as an opportunity to create well-paying, career-track local jobs. Supporting contractors to specialize and become skilled at electrification and heat pump projects is crucial for success, as faulty installations will slow electrification progress.

  State workforce development offices should begin to think about training programs now, including in high schools, trade schools, apprenticeship programs, and community colleges. Electrification can create an opportunity to help close the income gap, by creating good-paying high-road jobs. However, these training programs must be carefully calibrated with market demand to ensure the market is not flooded with trained individuals without jobs to receive them.

5. OPTIMIZE CUSTOMER AND MARKET OFFERINGS

In many parts of the country, markets for efficient electric products like heat pumps and heat pump water heaters are not well developed, and customers and contractors alike face barriers in installing these products. Outside of the Southeast, awareness of these products is generally low, contractors may perceive risks of introducing new technologies without clear demand signals from customers, workers may lack training on the specific products, and supply chains may not be well developed. To address these and other barriers, new programs aimed at developing these markets, increasing awareness, and improving customer and contractor experience with new technologies can help spur progress toward electrification.

Utility and state-run programs can encourage customers to electrify their homes, both by educating customers about opportunities and by offering incentives that make electrification more cost-effective and easily accessible. Regulators have an important role to ensure such programs are well-designed to meet customer needs, help manage the electricity system, make best use of ratepayer funds, ensure that the benefits of new technologies are distributed equitably among customers, and decarbonize the building stock quickly enough to meet state climate policies. Where markets are not mature, regulators will also need to consider how utility programs affect market development more broadly and how these technologies are treated in existing codes and standards.

In several states, policy and regulatory actions have started to rely on utilities—both all-electric and combined electric and gas—as the primary implementers of market transformation for heat pumps. Vermont's Renewable Energy Standard[44] requires utilities to acquire fossil fuel savings through energy transformation projects that switch customers away from direct fuel use. When the New York Public Service Commission announced an investment of $454 million for heat pumps from 2020–2025, it allocated this funding (and corresponding targets) to each of the state's investor-owned utilities to run customer programs.[45]

To effectively develop markets for electrification solutions, utility regulators around the country will need to encourage new programs and ensure they are effectively designed to achieve their goals. Several approaches to do so are described below:

- **Target programs and spending equitably to reach all customers.** To ensure equitable distribution of benefits, regulators can explicitly target programs to disadvantaged communities, as California has done with electrification pilots in the San Joaquin Valley, or establish carve-outs and standards to ensure that significant funding reaches low- and moderate-income customers. In either case, participation and input from customers and community-based organizations will strengthen program design by appropriately adapting it to local needs.

- **Support market transformation with upstream and midstream incentives and training.** In order for building electrification to progress at speed, market transformation is necessary in states with little existing market for heat pump solutions. Experience from Vermont and New York has shown that midstream incentives—targeted to wholesale distributors or contractors, rather than individual customers—have been successful in establishing nascent heat pump markets, when combined with supply chain engagement.[46]

California's newly proposed TECH program will take a similar approach, directing an initial $120 million budget toward midstream incentives and education and training programs.[47] Effective market transformation programs also incorporate varied funding sources beyond ratepayer-funded energy efficiency. For example, California's TECH program is funded from cap and trade proceeds. Maine's heat pump incentives use funding from several sources, including LIHEAP to support low-income customers, as well as the ISO New England capacity market.

- **Design effective customer-facing programs.** Well-designed customer programs and incentives can encourage electrification. The Sacramento Municipal Utility District (SMUD) has the most significant incentives today, offering over $10,000 for whole-home electrification.[48] Efficiency Maine and Efficiency Vermont also have robust incentive programs for heat pumps.[49] Many programs target the most economically attractive customer segments, such as oil, propane, and electric resistance customers.

  In all cases, customer-facing education and marketing have been important enablers of successful heat pump deployment. These include customer-friendly videos and product overviews on the internet, directories of qualified contractors, and other resources. Incentives should consider the full cost of going all-electric, including the costs of any potential panel upgrades. Without incentives for panel upgrades, customers may still face financial barriers to electrification.

- **Enable on-bill financing for electrification.** On-bill financing refers to a loan made to a utility customer, the proceeds of which would pay for energy efficiency improvements. Regular monthly loan payments are collected by the utility on the utility bill until the loan is repaid. Several electric cooperatives, including Roanoke Electric Cooperative and Orcas Power and Light, are already using on-bill financing to help customers electrify,[50] through models including Pay As You Save®, where the utility pays the installer for efficiency upgrades and then places a fixed charge on the customer's bill through a tariff.

  This recommendation includes adding on-bill financing options at utilities that don't currently have them, and expanding existing efficiency financing offerings to include electrification. On-bill financing can also support low-income customers or others who may not have the credit necessary for bank loans.

- **Bundle efficiency and electrification upgrades.** Combining building efficiency upgrades with electrification improves customer comfort and reduces winter impacts on electricity demand. This winter peak reduction is especially valuable in cold climates, which may experience significant increases in electricity demand during winter resulting from all-electric heating.

  Coupling electrification with efficiency can ensure that heat pumps are properly sized and configured, saving customers money and reducing carbon emissions and impacts on peak demand. Regulators should evaluate the importance of this coupling for their own states. Most likely it will be imperative in cold climates with older building stock, but less necessary in milder climates or those where the existing building stock is relatively efficient already. Where upgrades stop short of fully electrifying a building, there is a significant opportunity for "heat pump ready" programs, which weatherize buildings and upgrade electric infrastructure to prepare for electrification at a later date.

- **Expand demand response (DR) programs for all-electric buildings.** Buildings that rely on electric space and water heating have greater potential to provide grid services, and to return value to customers by monetizing these services. For example, Green Mountain Power provides a free smart control device to any heat pump customer who enrolls in its "eControl" DR program.[51] Sonoma Clean Power's GridSavvy program and PG&E's Water Saver program encourage customers to enroll heat pump water heaters in demand response.[52]

- **Support pilot projects that can scale quickly.** In order to have widespread, successful electrification programs, utilities will need to test new models and concepts through demonstration and pilot projects. PUCs and utilities both can allow for experimentation while also ensuring pilots support change at scale. To do so, pilots should be designed with explicit connections to decisions on scaling up new models, and clarity as to who will make scaling decisions on what timeline.

6. ALIGN EFFICIENCY POLICIES WITH DECARBONIZATION

Many energy efficiency policies and standards were designed at a time when fuel switching was not a cost-effective or environmentally beneficial choice. Updating these regulations is crucial to ensuring that utilities have the correct incentives to support electrification where it supports policy goals or offers other benefits, in addition to traditional energy efficiency. In order to ensure that efficiency policies do not create barriers to beneficial electrification, PUCs should consider the following:

- **Update energy efficiency resource standards (EERS) to be based on total energy across fuels or greenhouse gas emissions.** Today's efficiency targets typically require utilities to separately reduce customer electricity consumption on the basis of kWh and gas use on the basis of therms or Btus. Often, if a utility program helps a customer switch from a gas appliance or other delivered fuel to an electric alternative, there is limited or no opportunity for the utility to count savings toward their efficiency targets. The target definition and accounting can be updated with either total energy savings from a fossil fuel baseline to an electric alternative, or total greenhouse gas savings for the same switch.

  For example, the New York Department of Public Service has updated its technical resource manual with detailed guidance to account for total energy savings when switching from fossil fuel heating to heat pumps.[53] Sacramento Municipal Utility District (SMUD), an electric-only utility, has shifted its efficiency metrics to measure "avoided carbon" rather than kWh saved, allowing for continued investment in building electrification.[54] Even as these standards transition to total energy or emissions, it may prove valuable to maintain electricity efficiency sub-goals to ensure utilities continue to pursue effective measures like weatherization.

- **Reform cost-effectiveness criteria and evaluate how they support policy goals such as building decarbonization.** Utilities and commissions use cost tests to determine if the benefits of energy efficiency programs and measures exceed their costs. Such tests are important to ensure ratepayer funds are spent prudently, but may be limited in ways that effectively prohibit fuel switching, even when it supports climate and health goals. These tests may either fail to fully incorporate benefits and costs across fuels—for instance, counting customer savings from gas or nonregulated fuels like oil and propane—or undervalue nonenergy benefits to environment and health.

  A new National Standard Practice Manual currently under development aims to provide updated guidance on cost-benefit analysis for a range of distributed energy resources, and may serve as a useful guide to these reforms.[55] Regulators and policymakers should also consider how the concept of cost-effectiveness is applied to decisions that impact policy goals. In some cases, it may be worthwhile to implement programs that support policy goals even if they do not satisfy traditional cost-effectiveness tests.

- **Incorporate a social cost of carbon in cost tests.** A specific example of valuing nonenergy benefits came from the Colorado legislature in 2019,[56] requiring the PUC to take the social cost of carbon into account when assessing cost-effectiveness of electrification and efficiency programs. This change more fully values the emissions reductions of such programs and enables utilities to set incentives and other spending at levels commensurate with the benefits they offer. Applying such a value will require calculation of the carbon emissions of heat pumps and other electric equipment, which should account for the continued progress in reducing emissions from electricity generation.

- **Account for infrastructure costs that can be avoided with all-electric buildings.** Another opportunity to reform cost tests is to clearly account for avoided infrastructure costs of all-electric new construction or, in some cases, retrofit projects. For instance, if a utility offers a new construction electrification program, its cost test should include the avoided cost of gas distribution mains, services, and meters that will not be needed in an all-electric new development.

  Since a significant portion of these gas system extension costs are funded by ratepayers, there is a system-wide savings opportunity for customers that can be fully valued. This approach could include a set of standard costs that can be applied across a wide variety of situations (e.g., that an all-electric new housing development avoids $5,000 per house in gas infrastructure) and specific costs that can be identified in targeted situations (e.g., if electrification retrofits in thousands of homes avoids millions of dollars in gas capacity upgrades).

- **Remove prohibitions on fuel switching.** Some states have implicit or explicit restrictions on utility support of fuel switching, which are clear impediments to building decarbonization. In a recent policy brief, the American Council for an Energy Efficient Economy found that policies to enable fuel-neutral savings "are for the most part still in their infancy," and at least 10 states explicitly prohibit fuel-switching measures.[57]

  Minnesota's Conservation Incentive Program (CIP),[58] for instance, includes utility efficiency programs and includes carbon dioxide emissions reductions among its goals, but does not allow for fuel switching, even if it supports that goal. In 2019, the Minnesota Department of Commerce initiated a stakeholder process to explore whether conservation dollars should be available for fuel-switching programs and amended rules are now being considered in proposed legislation.[59]

  In Massachusetts, 2018 legislation authorized utilities to include electrification in efficiency programs that reduce greenhouse gas emissions,[60] even if they increase electricity consumption. In 2019, the California PUC altered its "three-prong test" to clarify how fuel switching measures can demonstrate cost and environmental benefits, removing one barrier to utility electrification programs.[61]

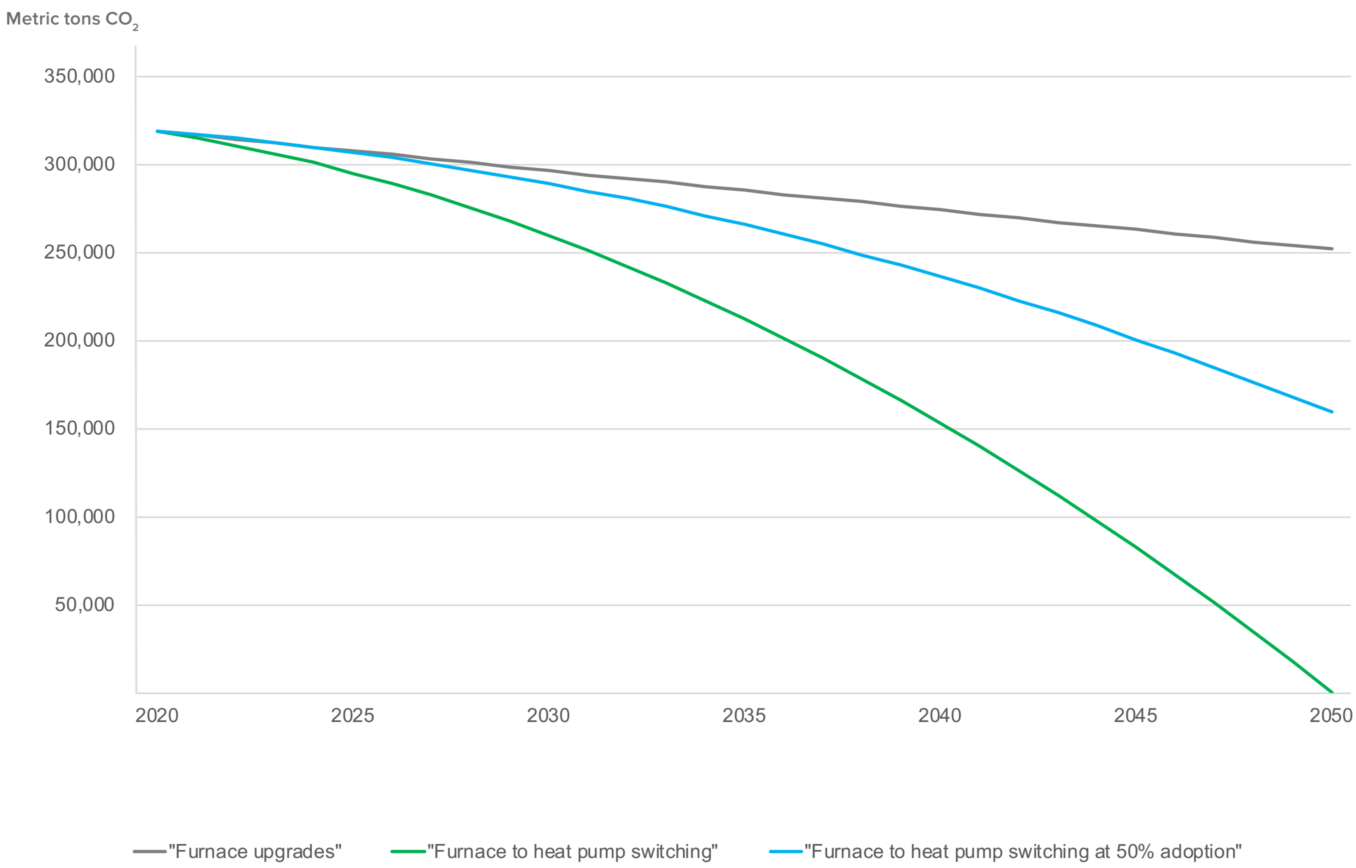
- **Phase out utility incentives for gas appliances.** Many gas efficiency programs today encourage customers to purchase new gas furnaces, boilers, and water heaters, based on the efficiency improvements new appliances offer compared to old appliances. This investment in a gas appliance is ultimately inconsistent with climate goals, because the modest emissions reduction from appliance efficiency is insufficient to keep pace with the 80–100 percent greenhouse gas reductions that will be required in many states.

  Gas stoves additionally pose health risks from worsened indoor air quality.[62] Regulators will need to establish clear criteria for when and how gas appliance incentives can be phased out, balancing near-term opportunities for modest carbon reduction with the lifetime of appliances, while also ensuring that LMI customers or others who cannot electrify are not disproportionately burdened by a phase out. State policy may need to change to allow such a phase out, particularly where utilities are required by statute to pursue all cost-effective gas reduction measures.

Exhibit 8 indicates the emissions saving potential from redirecting gas furnace incentive programs toward heat pump retrofits. In this illustrative example, an existing stock of 90,000 gas furnaces produces over 300,000 metric tons of CO_2 per year. While some emissions reductions are possible from replacing old gas furnaces with new ones (gray line), they cannot achieve deep decarbonization targets alone, while heat pump retrofits can (green line). Even if heat pump adoption is 50 percent lower at the same funding levels (blue line), the heat pump alternative produces greater emissions impact than continued focus on upgrading gas appliances.

EXHIBIT 8:

Heating Emissions Trajectory Comparing Gas Furnace Upgrades with Heat Pump Retrofits



Assumptions: stock of 90,000 gas furnaces replaced at a rate of 3,000 per year; average carbon intensity of US electric grid (943 lbs. CO_2/MWh) declines linearly to carbon neutrality in 2050; existing gas furnaces 75% AFUE, new gas furnaces 95% AFUE, heat pump COP=2.5

7. UPDATE ELECTRICITY RATE DESIGNS

Both electric and gas rate design may need reform to capture benefits and support affordability during a transition from gas consumption to electricity consumption. On the electric side, flexible demand from new loads can support a high-renewables grid. Well-designed time-varying electric rates and demand flexibility programs can ensure that the full value of electrified buildings is captured, and that customers can partake in the economic benefits of these attributes.

Building electrification at scale will also add electricity demand in winter, potentially creating winter demand peaks in regions that currently experience summer peaks. This load growth can be managed in part through smart rate design, demand flexibility, and targeted energy efficiency. As loads are being forecast, the shifting potential from smart rate design should be considered.

Rate design, especially when coupled with demand flexibility programs, can make electrification more cost-effective for customers. As is the case with electric vehicles, the additional volume of electricity sales can provide economies of scale, spreading fixed grid costs over larger volumes. For example, large new wildfire liability costs borne by California electric utilities can be shared across a larger volume of electricity sales, muting their impact on rates.

On the gas side, declining throughput on the gas system may create upward pressure on gas rates in order for utilities to recover the costs incurred to install, maintain, and operate the existing gas system with declining volumetric sales. Consumption and cost causation are likely to shift across customer classes, creating a need to reallocate costs among residential, commercial, industrial, and power generation customers.

Additionally, the long depreciation schedules assigned to gas infrastructure during the ratemaking process—typically many decades—contributes to keeping gas rates low, but will not be realistic for infrastructure which becomes unnecessary as the transition away from gas unfolds. Regulators may need to shorten these depreciation timelines to most accurately account for the costs of gas infrastructure.

To keep up with changing energy needs as buildings decarbonize, commissions can consider the following approaches to pursue affordable, stable electric rates for all, as a gas to electric transition begins:

- **Consider equity impacts of electric rate changes.** While time-varying rates are important to better reflect the true costs of delivering and generating electricity, as electric heat becomes more widespread, it is crucial to ensure that high price differentials (daily or seasonal) do not create a situation in which electricity is unaffordable during the days it would be most needed, for example, during the coldest days of winter. If seasonal costs shift to winter, customers on fixed incomes may also need new mechanisms to smooth out the variation in bills across the course of the year.

- **Eliminate or reduce inclining block electric rates.** Inclining block rates (aka tiered rates) charge a higher price for energy consumption above a set threshold; these structures historically encouraged energy conservation but now create a disincentive for electrification of both buildings and vehicles.

  Inclining block rates have also been promoted as a progressive means of making energy bills more affordable for lower-income customers, but electricity consumption is only weakly correlated with income. Inclining block electric rates may penalize low-income households with high energy use, and other approaches such as income-qualified discounted rates may be more effective in achieving this outcome.[63]

- **Expand time-varying electricity pricing with significant peak-to-off-peak price ratios.** To capture value from electrification's demand flexibility potential, the price differential in a time-of-use rate must be large enough to encourage beneficial load shifting, or alternate incentives must be offered through demand response programs.

  RMI analysis compared pricing ratios of 3:1 and 1.5:1 in California, and found that customers with the higher pricing ratio could save 16 percent on their heating and cooling energy costs, compared to those with the smaller ratio.[64] Such a result does require that customers have access to the technology that can optimize the timing of their energy usage to capture these benefits.

- **Reevaluate the use of fixed charges to offset volumetric electric rates.** The allocation of costs between fixed and volumetric charges on a customer's bill presents both opportunity and risk. Increasing fixed charges on electric bills, while decreasing volumetric rates, may incentivize electrification by decreasing the marginal cost of electricity consumption. But such a change may also disincentivize customer-sited solar generation by changing the economics of net metering, or impose undue costs on low-usage customers who would face higher bills.

  Commissions should weigh these tradeoffs on a case-by-case basis, recognizing that electrification goals may introduce new considerations that were not previously apparent. Where increased fixed charges are employed, commissions can consider making those opt-in as a means to match their adoption with customers who choose to adopt electrification strategies (building electrification as well as EV charging), while not imposing high fixed charges on low-usage customers.

- **Limit demand charges in electric rates.** Demand charges, particularly non-coincident demand charges, encourage higher customer load factors (e.g., flatter load profiles), rather than load profiles strategically shaped to match grid needs. They may also penalize customers for spikes in energy use, regardless of whether those spikes occur during costly times for the grid. Time-varying volumetric rates that more accurately encourage beneficial load shifting into low-cost times can offer greater value from demand management while addressing the same cost recovery objective that demand charges seek to fill.

- **Consider new electric rate concepts, such as subscription models.** Other innovative rate design options may be well-suited to electrification, including subscription models that offer consistent, predictable pricing (subject to consumption limits or other guidelines). Rate design may also be incorporated into business model changes such as heating-as-a-service offerings or district heat service.

  As a result of SB 1000 in California, PG&E and SoCal Edison both introduced new commercial electric vehicle rates. PG&E offers a "subscription model" with a monthly charge for a certain amount of charging capacity, with time-varying charging prices. While these rates are specific to EVs, innovative models could also be developed for building electrification.

- **Reevaluate cost allocation and depreciation schedules for gas rates in a changing system.** As gas volumes decline, the nature of cost causation may also shift, particularly from residential and small commercial customers to larger customers. Commissions may need to reevaluate cost allocation methodology in response, mitigating potential rate increases for residential customers.[65]

  Additionally, commissions should reconsider the standard timelines for depreciating gas assets. Long timelines mitigate impacts on gas rates but imply an expectation for continued gas use which can be inconsistent with climate policy and create long-term financial risk for ratepayers.

8. EXPAND ENERGY SYSTEM PLANNING

Traditionally, gas system planning and electricity system planning have been conducted in isolation from each other. Regulation of gas and electricity has focused on a limited set of objectives, including ensuring just and reasonable rates and service reliability and safety. In recent years, electricity system regulation has begun to embrace a broader set of goals, including climate mitigation and resilience, but gas utility regulation has retained a limited focus on traditional goals.

To support decarbonization of the residential and commercial end uses served by gas distribution utilities, regulation must evolve. In this section we describe opportunities to do so, focused on combined electricity and gas planning, resilience, the PUC role in capacity planning, and planning for gas infrastructure retirements.

- **Plan for electric grid impacts of electrification.** As more end-uses are served by electricity that were once served by gas, oil, or propane, usage of the electricity system will increase. This can have cost benefits for electric ratepayers—for instance, if fixed wildfire mitigation costs in California are spread across a larger volume of kWh sales, their rate impact will be smaller. But it also adds new infrastructure requirements, for instance upgrading transmission and distribution systems in cold climates with growing winter peaks.

  New Jersey's Energy Master Plan showed that the least-cost decarbonization pathway includes electrifying the vast majority of buildings in the state, contributing to more than doubling peak electricity demand and a shift from summer to winter peaking.[66] Regulators must plan to minimize the impacts of electrification and ensure electric grid upgrades are conducted cost-effectively.

- **Enhance energy system resilience along with electrification.** With greater reliance on electricity for heat, hot water, and cooking comes an opportunity and imperative to improve resilience of energy service. Today's electricity and gas systems are both highly reliable, but in instances of severe service disruption both may be interrupted. In most cases, neither gas nor electric heating equipment functions during power outages.

  With both increased prominence of all-electric buildings and greater incidence of natural disasters, utilities and regulators can pursue greater resilience through higher adoption of site-level solar and storage, community microgrids, and/or advanced grid controls which enable segmentation of the electric grid to isolate outages. Other resilience measures include physical grid hardening, which can reduce the incidence of outages during natural disasters.

- **Increase the PUC role in reviewing gas capacity expansions like new pipelines.** While electric regulation increasingly requires robust integrated resource planning, including evaluation of non-wires solutions, gas utility capacity expansions have not always faced the same level of scrutiny. PUCs should rigorously assess the need for new gas capacity in light of state climate policies, perhaps considering joint utility planning across electric and gas systems to ensure that customer's heating and power needs are served, even during a gas to electric transition.

  In March 2020, the New York PSC opened a proceeding to examine gas planning procedures, requiring all gas planning to include consideration of non-pipes solutions. Additionally, the PSC focuses on "policy-aligned" gas planning, meaning that any long-term gas planning must be consistent with New York's aggressive climate goals.[67]

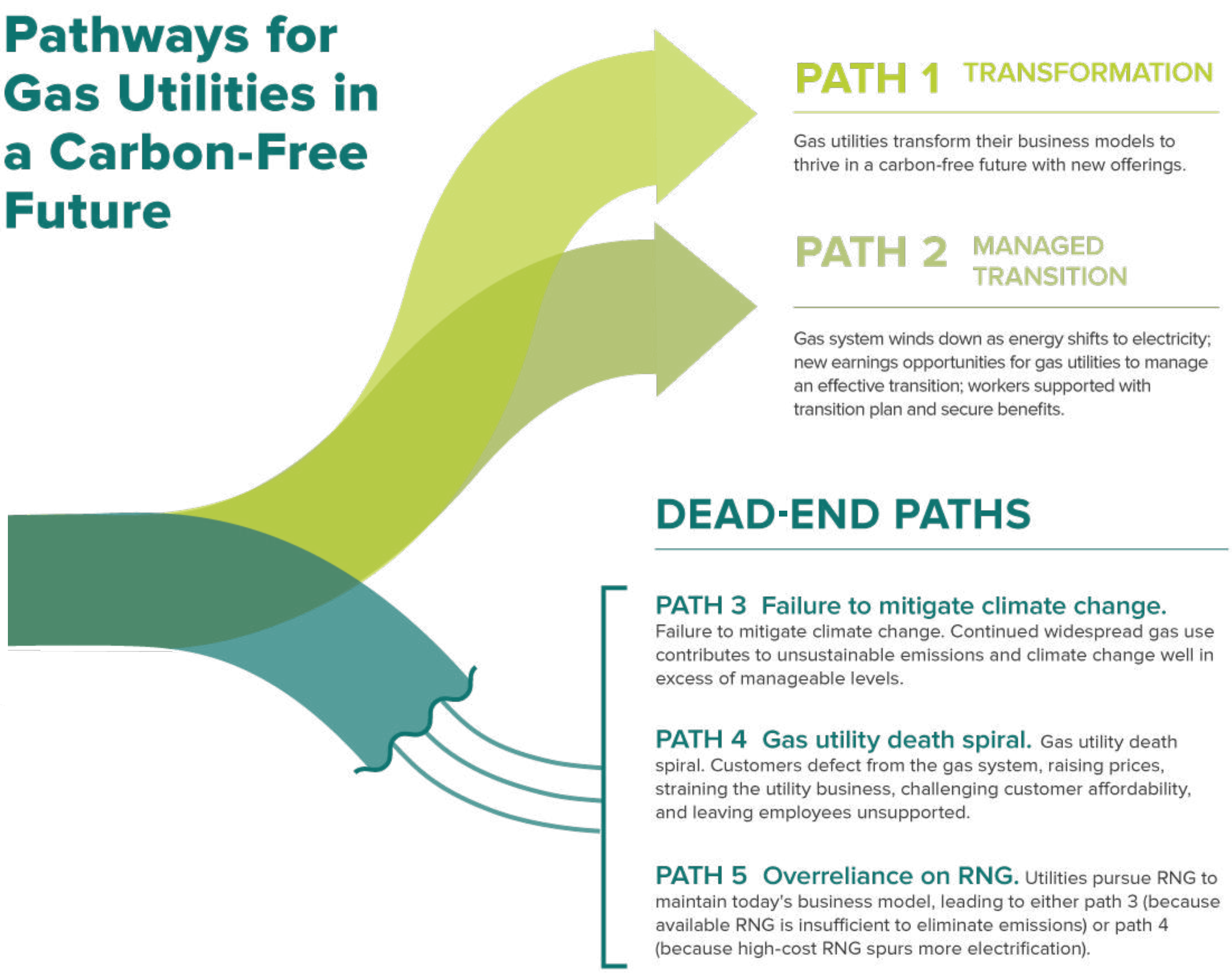
- **Develop plans for deliberate electrification and retirement of sections of the gas delivery system.** If electrification progresses randomly, with scattershot decisions made building-by-building and appliance-by-appliance, gas system utilization will fall and some clusters of customers may require substantial infrastructure to serve minimal demands, perhaps for small end uses like cooking. Maintaining the entire system to serve minimal customer loads would challenge affordability and potentially shift costs substantially from low-usage (e.g., cooking-only) customers to others less able to electrify. Regulators could work with utilities to develop targeted electrification plans and provide a pathway to implement them, in order to retire segments of the gas system and manage costs during a gas to electric transition.

MODERNIZE UTILITY BUSINESS MODELS

Today's gas utility business model is not well aligned with decarbonizing the buildings sector. The regulated gas utility business is based on planning, building, maintaining, and operating a network of pipes and other infrastructure to deliver gas to homes, businesses, industrial facilities, and sometimes power plants. This status quo will not be feasible in the future; continuing to distribute and burn this gas in the same way is incongruous with a decarbonized world.

In this section we frame broadly two potential pathways for gas utilities in a decarbonizing economy and recommend specific regulatory mechanisms available in the near term to support this transition. Importantly, the onus for transformation cannot lie solely with utilities themselves. Regulators, policymakers, and shareholders must also create viable transition pathways together with utilities to even make such transformation possible.

EXHIBIT 9:
Pathways for Gas Utilities in a Carbon-Free Future



There are two potential desirable long-term paths for gas utilities: **1) transforming their business model to thrive in a zero-carbon future** or **2) managing a gas transition as customers switch from gas to carbon-free electricity for heat, and the gas delivery system as we know it goes away.** These paths may be combined (i.e., a utility may offer new services during a transition period as it reduces the size of the gas system).

Other long-term pathways are possible but not desirable, as they pose severe societal consequences—failure to reduce greenhouse gas emissions and suffering the consequences of unmitigated climate change and/or a "death spiral" and chaotic collapse of the gas utility business. A collapse could cause escalating energy costs creating affordability crises for customers and straining the reliability of the system, and poorly planned business failures would leave employees unsupported and unprepared to transition.

Avoiding these outcomes requires strategic planning starting now. The California PUC recently launched a proceeding aiming to explore long-term planning and policy, which could create such an opportunity.[68] New York has also initiated a proceeding focused on natural gas planning.[69]

This transition will look very different for utilities that only sell gas, as compared to combined-fuel utilities that sell both gas and electricity. Among other strategies, combined gas and electric utilities may be able to wind down their gas distribution system, shifting their customers, revenue streams, and capital investments toward the electric side of their business.

Gas-only utilities, lacking the opportunity to shift revenue to a different business unit, must either transform by adopting entirely new business models or seek to maximize profit along a managed wind down of their distribution systems. And while some gas utilities are currently proposing a continuation of today's business model with "renewable natural gas" (RNG) substituting for fossil gas, we do not consider this to be a viable model, given the limited scale of affordable RNG resources.[70]

PATHWAY 1: Transform the gas utility business model to thrive in a carbon-free future. Gas utilities may be able to create new revenue opportunities to shift focus, providing heating and cooling to customers in new ways that enable a carbon-free transition while remaining a viable business. Three potential models are described below. These are largely untested for regulated utilities, posing uncertainty about their viability and whether these business models are appropriate for regulated monopolies. These models may be used in conjunction or sequence with one another, and there may be other creative models not yet conceived.

- **Heat as a service.** The utility provides services such as thermal comfort or heat, rather than commodities like cubic feet of gas. This could start as a new service arrangement with the customer's existing heating equipment—for instance, providing maintenance for furnaces, boilers, air conditioners, and water heaters in the short term, and replacing with heat pumps when existing equipment nears end of life.

  Under this model the customer pays consistent monthly bills throughout the transition, combining the costs of energy provision and other value-added services. Such a model could enable the utility to coordinate building-level equipment changes with managed retirements of gas distribution infrastructure, or with opportunities to construct district heat systems as described below.

- **Carbon-free district heat.** The utility manages the planning, engineering, construction, operation and maintenance of clean district heating and cooling infrastructure. These systems may include ground-source heat pumps on a shared ground loop, or other carbon-free approaches to district heat. This model could take advantage of existing utility capabilities, for example, planning and executing underground construction work, operating infrastructure networks, billing, and customer service.

- **Green hydrogen.** The gas company produces, stores and distributes green hydrogen produced through electrolysis, which can be used as fuel for hard-to-abate industrial processes or for seasonal energy storage on the electricity system. This would entail a shift away from local energy distribution to many small customers, toward distribution to fewer and larger customers.

PATHWAY 2: A managed transition from reliance on the gas system to the electric system for residential and commercial buildings. On this path, the gas distribution system is retired, perhaps with limited exceptions for a smaller gas business to distribute hydrogen to hard-to-electrify industrial customers.

This would require long-term system planning for shrinking gas throughput, including a sequence of targeted retirements of gas delivery infrastructure as clusters of customers are converted off gas entirely. It would also necessitate planning a labor transition and aiding individual customers' building-level conversions. In addition, even as the amount of delivered gas continues to decrease, utilities should ensure the gas they do procure is **produced with minimal methane leaks**.

Managing this transition deliberately provides several advantages, compared with allowing it to unravel haphazardly:

- First, it will be **less costly**. A managed transition strategy would decrease stranded costs by avoiding new gas infrastructure wherever possible and sequencing a targeted retirement plan of existing infrastructure—shutting down whole sections of the gas grid community by community, rather than operating the entire system to serve diminished load scattered across a utility's service territory. In an assessment for the state of California, Gridworks found that gas rates would be four times as costly without a managed transition. Similarly, research from EDF evaluates several important strategies for managing stranded asset risk as gas use declines.[72]

- Second, a managed transition will ensure **protections and transition opportunities for gas utility employees.** A skilled gas workforce will be needed to continue to operate the system safely during this transition, and to properly decommission assets, after which workforce needs will shrink and shift. This transition can protect and support workers only if planned well in advance.

New performance-based business models should be developed to offer incentives and remove barriers for utilities to pursue a well-managed transition, and offer profit opportunities as needed to gas-only utilities as they shrink their business. These can include the mechanisms described below—decoupling, performance incentive mechanisms (PIMs), and shared savings mechanisms (SSMs)—as well as other creative models yet to be developed.

But as stated above, utility incentives alone will be insufficient. Additional changes to fundamental rules, for instance the obligation to serve gas customers, will also be required for this transition to succeed.

Near-Term Utility Business Model Opportunities

While these long-term pathways for gas utility transition are being considered, we recommend implementing other utility business model reforms that can encourage building decarbonization. Many of these are already implemented in some electric and gas utilities.

- **Expand revenue decoupling.** Both gas and electric utilities' revenues should be decoupled from sales volumes. This will eliminate the direct profit incentive to increase gas sales volumes and provide assurance of cost recovery during a managed transition as gas sales diminish. Decoupling can ensure that utility revenues are as determined in a rate case, regardless of gas sales in a given year.

  Further, in decoupled states with increased electric sales from electrification, decoupling can ensure that ratepayers see the benefits rather than shareholders. If revenues in a given year are higher than expected due to electrification, rates will adjust down the following year to compensate.

  Many states already have decoupling policies in place—to date, 26 states allow for gas decoupling and 17 states have electricity decoupling.[73] In some states, decoupling is conducted on a per-customer basis, which means that utilities still have an incentive to add customers to their system. Such policies can be adjusted on the basis of total sales volume rather than per-customer volume.

  Performance mechanisms, including PIMs, earning adjustment mechanisms (EAMs), and shared savings mechanisms (SSMs), are all business model reforms that could be used to encourage a utility toward supporting electrification.

- **Introduce performance incentive mechanisms (PIMs).**[ii] PIMs allow a utility to earn a return for meeting specific objectives that are in the public interest. Some penalize utilities for underperforming against a particular metric. PIMs can be used to incent utilities to design programs and make investments that they would not under a pure cost-of-service model.

  For example, in New York, ConEdison can earn a profit through an earnings adjustment mechanism on successful beneficial electrification, with the opportunity to earn up to $14.5 million in 2020 for successful greenhouse gas reduction through EV and heat pump deployment. Other incentive concepts could emphasize avoiding additional peak infrastructure, or could reward gas utilities for successful decarbonization, even when that means losing customers who adopt heat pumps as alternatives to gas.

  In some cases, shared savings mechanisms could be used to incent a utility to pursue non-pipes solutions to avoid new or upgraded gas infrastructure. By implementing electrification, efficiency, or demand response, the utility could avoid new capital investment, and share those savings between shareholders and ratepayers.

- **Reform operating expense and capital expenditure accounting.** Utilities typically earn a return on capital expenditures but not on operating expenditures, resulting in a bias toward capital even when other solutions could better meet customer needs at lower cost. Also, utilities are often barred from substituting an operational expenditure solution for a pre-approved capital expenditure solution, even when it is lower cost.

[ii] Performance incentive mechanisms (PIMs) are called earnings adjustment mechanisms (EAMs) in New York

One solution to counteract this bias would allow the utility to earn a rate of return on a service rather than implementing a capital investment solution—for example, a demand flexibility program rather than expanding system capacity. A complete overhaul of accounting to put operating and capital expenses on level footing—referred to as "totex" accounting—can also address these challenges.

While there may be important short-term roles for these solutions, tweaks around the edges alone are unlikely to incent gas utilities into an entirely new business model, or to enable a utility to chart a new course without a well-defined path from their regulators. More fundamental change will be needed in the long term, for instance a target date by which gas will no longer be served in a given area, which will require clear direction and vision from state leadership.

MANAGE INFRASTRUCTURE AND STRANDED ASSET RISK

Natural gas utilities are currently investing in expanding and replacing gas infrastructure based on the expectation of continued gas consumption for decades to come, an expectation that is inconsistent with the need to decarbonize buildings and eliminate GHG emissions.

These investments may be driven by utility planning, customer requests, or compliance with safety standards, but in all cases the 30+ year depreciation lifetime of these investments means that most of this new infrastructure will not continue to be used or useful over a significant portion of its lifetime and risks becoming a stranded asset. Continued investment in this infrastructure burdens ratepayers with the future costs of these stranded assets.

In order to manage these risks and avoid "digging the hole deeper," commissions must be proactive in developing clear strategies for winding down infrastructure investment and managing costs of existing infrastructure.

Investment in the gas delivery system falls into a few different categories:

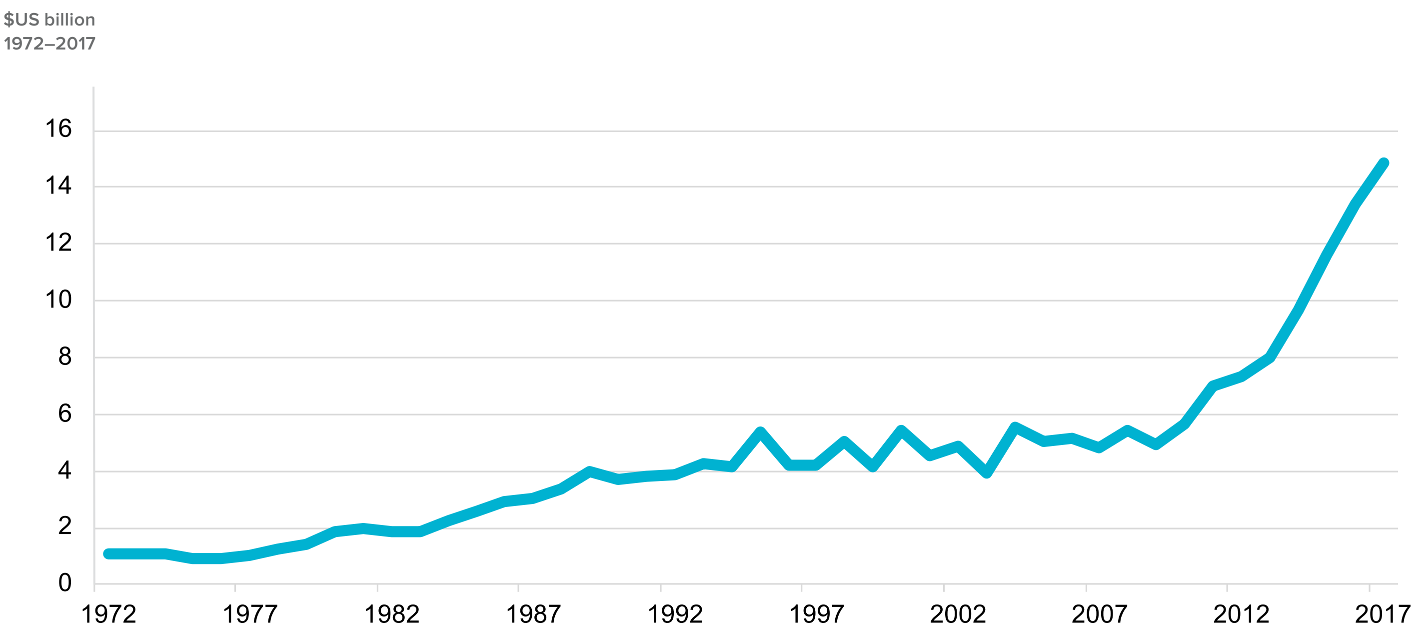
1. **Line extensions:** The gas distribution system is expanding 9,800 miles per year to bring natural gas to homes and businesses that previously did not have service.[74] The costs of most of these line extensions, especially for residential customers, are socialized among rate payers, locking in cost for decades to come, regardless of how much natural gas is consumed.

2. **Capacity expansion:** When natural gas demand increases, pipelines, storage facilities, and other infrastructure is often upgraded or built new in order to safely deliver the necessary quantities of natural gas. In New York State, capacity expansion has been an ongoing discussion in recent years, with ConEdison's capacity constraints in Westchester County as well as National Grid's downstate capacity constraints and proposal for the new NESE pipeline.

3. **Replacements:** Much of the natural gas system in the United States is planned for replacement to improve safety and reliability and reduce methane leakage. Over the last decade, 5,600 miles of the gas distribution network have been replaced per year.

4. **Modernization and other upgrades:** Other investments in the gas system modernize infrastructure with automation, enable new inspection techniques, or provide other reliability and safety enhancements other than replacing or adding major infrastructure.

Exhibit 10:
US Gas Distribution System Expenditures Have Risen Dramatically in Recent Years



Sources: American Gas Association 2017, RMI analysis

Electrification can offer the opportunity to avoid these investments, and accounting for these avoided costs is an important part of determining cost-effectiveness of electrification. Some cases will be simpler than others—for instance, avoiding line extension costs for ratepayers could be achieved by eliminating gas line extension allowances altogether. Avoiding the costs of infrastructure replacement projects will be more complex, requiring new processes to collectively transition a target group of customers off gas and retire shared assets rather than replacing them. Specific recommendations include the following:

- **Update gas line extension allowances.** Typically, a portion of the cost of new gas service extension is paid by the utility (and socialized among ratepayers), with the remainder paid by the customer or developer of the new property. The line extension allowance—the amount the utility can pay toward this cost—is determined by PUCs and generally based on the presumption that the customer will pay enough in gas bills over 30–60 years to cover the costs that were socialized among other ratepayers when the line was extended.

  While the specific calculations vary state to state, utility customers everywhere face the same risk: that gas use will diminish much sooner than the line extension costs can be recovered from the customer who benefited from the allowance. This will leave all ratepayers on the hook for these costs. In order to both mitigate ratepayer risk and to support decarbonization policies, PUCs should reevaluate line extension policies and consider eliminating them.

- **Require evaluation of non-pipes solutions.** Rather than expanding a pipeline or reinvesting in infrastructure, utilities and commissions should assess opportunities for "non-pipes solutions," just as the electricity industry has begun to prioritize non-wires solutions over more expensive infrastructure investments. Regulators and utilities should work together to ensure utilities can offer heat pump incentives, efficiency retrofits, demand response programs, or other solutions and avoid further investment in the gas infrastructure system. While these opportunities may prove valuable individually, a broader program of electrification, efficiency, and demand response can ultimately be most effective in avoiding gas capacity expenditures system wide.

- **Establish a process to retire shared assets.** As more and more customers electrify and gas use diminishes, it will be necessary to decommission sections of the natural gas system. This will require new approaches to ensure large groups of customers all transition their buildings before a shared deadline, and may require targeted incentives to customers based on location on the gas network, along with other new solutions.

  PUCs should be proactive in designing a participatory process for this purpose. In order to retire shared assets, legislative changes may be required to reform utilities' obligation to serve customers willing to pay reasonable rates for gas service. In a future of declining gas use, it is possible that a small number of customers demanding continued gas service would preclude retirement of a large section of gas delivery infrastructure, imposing high system costs disproportionate to the bills they are paying.

- **Create a gas system transition fund.** A comprehensive transition away from the gas distribution system will result in transition costs and force decisions as to who pays these costs. The magnitude of this challenge can and should be reduced by eliminating allowances for extending the gas system, pursuing non-pipes solutions in place of capacity expansions, and establishing procedures to retire shared assets rather than replace them, as described above.

  But even with such measures, costs will remain: stranded costs of unused assets, operations and maintenance costs of maintaining a gas system until all customers transition off, and decommissioning costs of infrastructure. These costs also come with the risk that the customers least able to depart the gas system will bear them.

  To ensure equitable allocation of the costs and benefits—health, economic, and environmental—of the gas transition, new funding sources will be needed. States can establish gas system transition funds to close this gap, and use varied sources to capitalize such funds. These include proceeds from carbon pricing programs, utility shareholder contributions, electric ratepayer contributions, and general taxpayer funding.

CONCLUSION

Today's utility regulation status quo is holding back rapid progress in eliminating the building sector's contributions to climate change. This report provides a wide range of recommendations for regulatory reform, but implementing such change will be challenging for commissions and staff.

In some cases, commissions are beginning to pursue comprehensive proceedings to explore these issues, as the California PUC has recently initiated.[75] In other cases, changes are being made one issue at a time, as with the New York PSC's new proceeding on gas planning and non-pipes alternatives.[76] Some utilities are able to institute changes on their own, as several rural electric cooperatives have done in launching on-bill financing for heat pumps.[77] And often, action will need to be initiated in the state legislature, as was the case in Colorado when new policy in 2019 required utilities to factor a social cost of carbon into efficiency cost tests.[78]

The important thing is getting started and addressing the issues most critical in your state whenever the opportunity arises. Commissions, legislators, utilities, and advocates all have a role to play in clearly articulating the need for change and exploring solutions outside the bounds of traditional utility programs and regulations. Climate action—along with eliminating air pollution and improving energy affordability—will require transforming the role of the utility sector, and regulators are well positioned to initiate this transformation right away.

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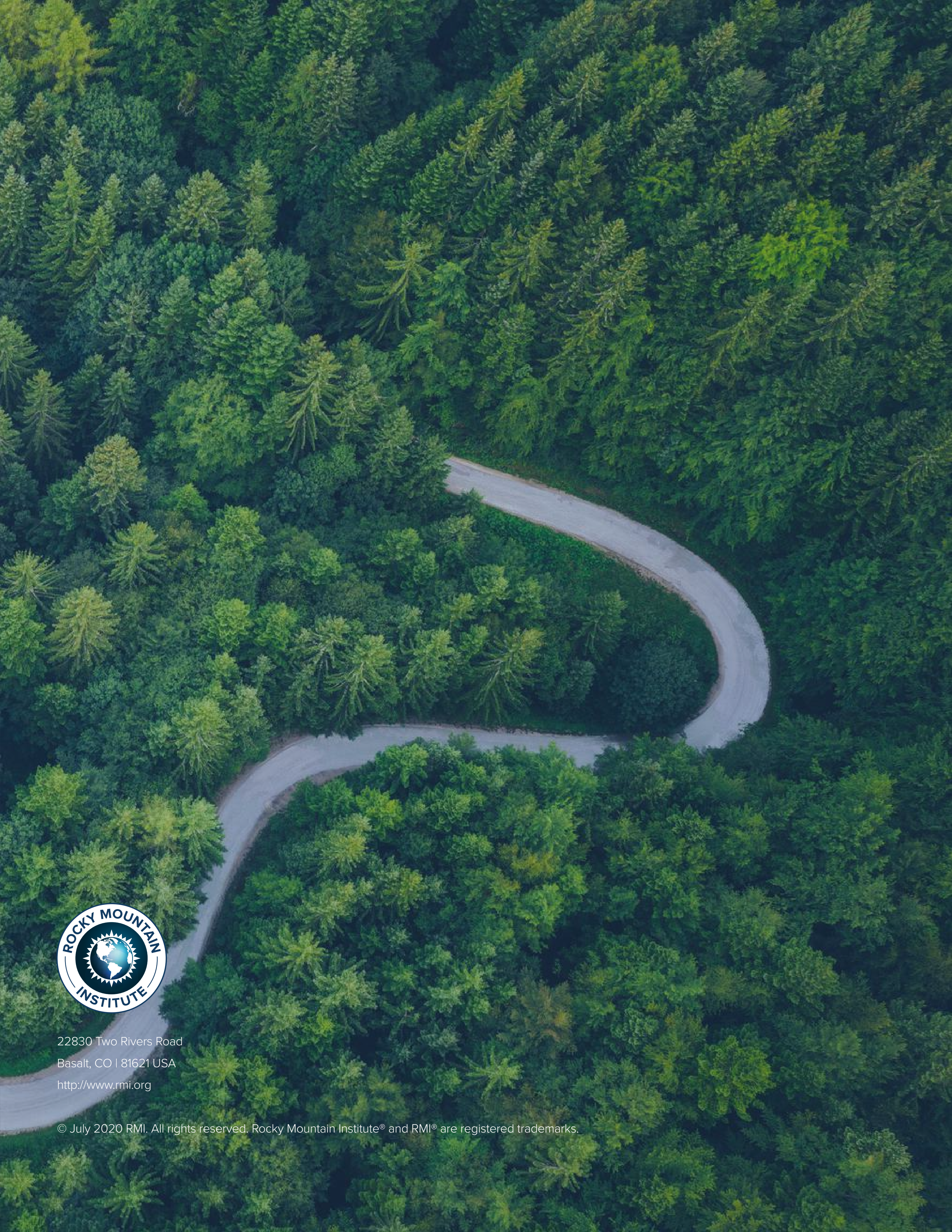

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