BUILDING *toward* DECARBONIZATION

Policy Solutions to Accelerate Building Electrification in High-Priority Communities

JANUARY 2021
Policy Report

Climate Change and Business *Research Initiative*

Berkeley Law | Center for Law, Energy, & the Environment

UCLA School of Law Emmett Institute on Climate Change & the Environment

BANK OF AMERICA

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ABOUT THIS REPORT

This policy report is part of a series on how specific sectors of the business community can drive key climate change solutions and how policymakers can facilitate those solutions. Each report results from workshop convenings that include expert representatives from the business, academic, policy, and environmental sectors. The convenings and resulting policy reports are sponsored by Bank of America and produced by a partnership of UC Berkeley School of Law's Center for Law, Energy & the Environment (CLEE) and UCLA School of Law's Emmett Institute on Climate Change and the Environment.

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The Center for Law, Energy & the Environment (CLEE) channels the expertise and creativity of the Berkeley Law community into pragmatic policy solutions to environmental and energy challenges. CLEE works with government, business and the nonprofit sector to help solve urgent problems requiring innovative, often interdisciplinary approaches. Drawing on the combined expertise of faculty, staff and students across University of California, Berkeley, CLEE strives to translate empirical findings into smart public policy solutions to better environmental and energy governance systems.

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The Emmett Institute on Climate Change and the Environment is among the leading environmental law programs in the country, with faculty members renowned for their public service, teaching excellence, and scholarship in state, federal, and international law. Located in Los Angeles, a diverse city facing unique environmental justice and climate change challenges, the Emmett Institute provides J.D. and LL.M. students unmatched opportunities for mentoring, career placement, and experiential learning. Through groundbreaking research and public interest initiatives, the Emmett Institute helps shape climate change and environmental law and policy in California, the United States, and jurisdictions around the world

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We dedicate this series to the memory of James E. Mahoney (1952-2020), who helped launch it and championed sustainability initiatives throughout his impactful career.

INTRODUCTION & EXECUTIVE SUMMARY

California's drive toward statewide carbon neutrality by 2045 relies on two related transitions: completely decarbonizing the state's electrical grid; and shifting as many energy sources and fuels to electricity as possible.

Residential and commercial buildings, which are responsible for over twenty percent of California's greenhouse gas emissions, represent a particularly vital component of this effort. Appliances in these buildings that run on natural gas, such as stovetops, furnaces, and water heaters, are responsible for a significant portion of California's greenhouse gas emissions. Powering these appliances instead with electricity, using technologies that are commonplace and increasingly economical, obviates the need for natural gas connections and could save up to 10 percent of statewide greenhouse gas emissions as the grid decarbonizes. When combined with advanced metering systems and grid management software, these technologies are also capable of providing automated and remote load management through flexible usage, which can help integrate renewable energy sources into the electrical grid. They also can significantly improve indoor air quality and public health. As a result, many California cities, recognizing the urgency of the need as well as the potential economic savings, are enacting local measures to phase out natural gas in new buildings.

However, building electrification also presents a challenge for state energy regulators, utilities, residents, and businesses. While advanced building electrification technologies are becoming increasingly affordable, and new construction can be highly efficient and entirely electrified, retrofitting existing buildings can be expensive and complex. Current utility business models, high upfront costs and long payback periods for electrification projects, split incentives between tenants and owners, construction challenges, and legal and social barriers to the reduction of natural gas service are all significant obstacles to electrification. These challenges are greatest in lower-income communities that lack capital and capacity to retrofit buildings, are home to

a greater number of multifamily structures, and suffer from higher rates of air pollution and environmental injustice. As state and local leaders develop plans to accelerate building electrification, they must also develop processes to identify high-priority communities for targeted resources, incentives, and policy and technical support.

To address these challenges, UC Berkeley School of Law's Center for Law, Energy and the Environment (CLEE) and UCLA School of Law's Emmett Institute on Climate Change and the Environment convened leaders from state and local government, utilities, and environmental and economic development organizations in September 2020 to identify top-priority policy solutions. This policy brief outlines the vision these stakeholders described for decarbonizing buildings in California's high-priority communities; the key barriers limiting progress toward that vision; and actionable solutions to overcome those barriers.

First, the state should prioritize building electrification in communities with the following characteristics:

1. **Lower-income and disadvantaged communities** that have the most to gain from improved air quality and the fewest financial resources to invest.

2. **New construction** that can rapidly and most affordably avoid installation of new gas infrastructure.

3. **Communities with existing gas infrastructure near the end of its useful life** that is already in need of near-term replacement.

4. **Communities that are willing to participate in the transition** and will generate the least political opposition or delay of critical actions.

5. **Communities rebuilding from wildfires** that require new utility distribution infrastructure to return to service, regardless of type.

The top barriers and solutions include:

BARRIER #1: A LACK OF CONSISTENT STATE POLICY LIMITS THE PACE OF THE TRANSITION

Solutions

- **The governor** could issue an executive order affirmatively declaring that advancing building electrification is a policy priority for the state.
- **The state legislature** could enact a law setting a clear timeline for the electrification transition.
- **The state legislature** could clarify the utility obligation to serve in order to facilitate the transition away from natural gas.

BARRIER #2: POLITICAL RESISTANCE TO TRANSITIONING AWAY FROM THE LEGACY SYSTEM LIMITS STATE PLANNING AND UTILITY INVESTMENT

Solutions

- **The California Energy Commission and Public Utilities Commission** could initiate a joint process to identify pathways to financial certainty for the phase-out of existing infrastructure.
- **The California Labor and Workforce Development Agency** could collaborate with labor unions and community-based organizations to craft pathways and establish labor standards for workforce certainty in the electrification transition and to inform California Energy Commission and Public Utilities Commission planning.
- **The California Public Utilities Commission** could thoroughly review utility expenditures to ensure that the costs of gas promotion and lobbying activities are not recovered using ratepayer funds.

BARRIER #3: STAKEHOLDER CAPACITY LIMITATIONS AND RESISTANCE TO SHIFTING FUEL SOURCES PREVENT COMMUNITIES FROM REACHING CONSENSUS ON TRANSITION PRIORITIES

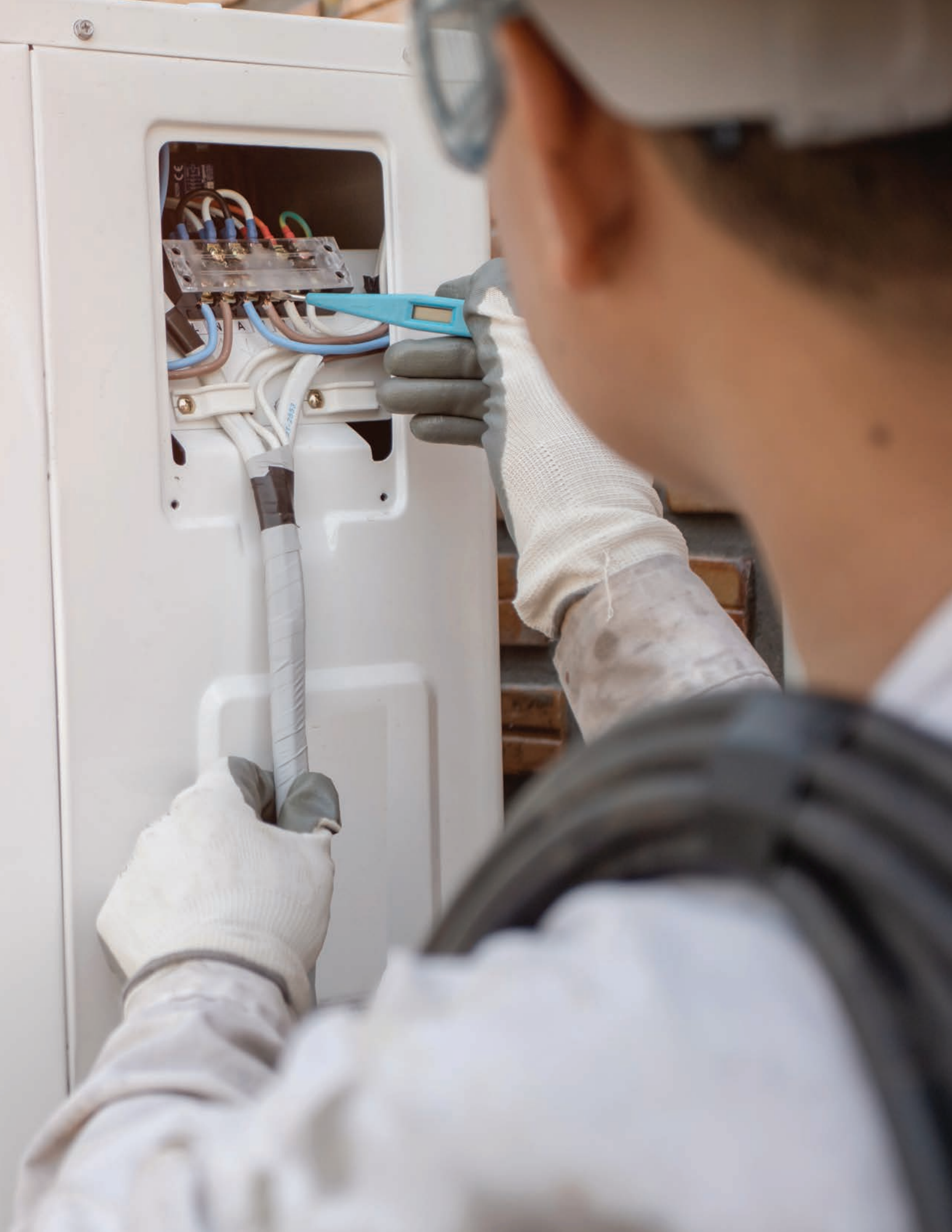
Solutions

- **The state legislature** could appropriate funds for the California Energy Commission and California Public Utilities Commission to fund outreach and technical assistance through community-based organizations.
- **The California Public Utilities Commission** could direct electric utilities to develop advanced dynamic rates to increase the financial benefits of electrification by compensating customers for real-time use changes in response to grid needs.
- **The California Energy Commission, Public Utilities Commission, and Air Resources Board** could initiate a public messaging campaign on the benefits of electrification.

BARRIER #4: CHALLENGING ELECTRIFICATION ECONOMICS INCREASE THE NEED FOR PUBLIC FUNDS AND INCENTIVES

Solutions

- **The state legislature** could appropriate short-term funds to help defray the upfront costs of retrofitting and installation for high-priority communities.
- **The California Public Utilities Commission** could incorporate into rates, with equity offsets, all public costs of natural gas' public health, climate, and stranded asset risks.
- **Utilities** could work with customers, retrofit providers, and community-based organizations to identify appliances ready for replacement in existing buildings and target them for electrification.



I.
OVERVIEW: CALIFORNIA'S BUILDING ELECTRIFICATION PRIORITIES

A. RAPID BUILDING ELECTRIFICATION IS AN EMISSION REDUCTION AND PUBLIC HEALTH IMPERATIVE

Residential and commercial buildings are responsible for nearly one quarter of California's greenhouse gas emissions, and combustion of natural gas—primarily in space heating, water heating, and cooking applications—accounts for approximately 10 percent of total emissions.[1] As the state progresses toward its emission reduction goals of 40 percent below 1990 levels by 2030 and statewide carbon neutrality by 2045, legislators and regulators have begun to recognize building decarbonization as a central component of state strategy.[2] Building electrification—replacement of natural gas-powered end uses with electricity-powered systems—is an essential means to achieve state greenhouse gas emission reduction targets.[3] But progress at the rate needed to meet those targets will require significant policy support.

In 2015, Senate Bill 350 (De León) directed the California Energy Commission to develop a plan to double energy efficiency savings by 2030, in connection with state renewable energy procurement goals; and in 2018, Assembly Bill 3232 (Friedman) directed the Energy Commission to assess the potential for the state to reduce residential and commercial building emissions 40 percent below 1990 levels by 2030, in order to achieve statewide greenhouse gas emission targets.[4]

The Energy Commission has identified "a combination of clean energy supplies, deep energy efficiency improvements in buildings and appliances, and electric demand flexibility" as necessary to achieve these reductions, and acknowledged that "the state must wean itself from fossil natural gas wherever feasible" as part of this effort.[5] Complete electrification can reduce greenhouse gas emissions from residential buildings by up to 45-55 percent, and potentially up to 85 percent or more in a future decarbonized electrical grid.[6] Building electrification will also drive integration of smart heating/cooling systems and appliances, which can deliver significant efficiency benefits to the electrical grid (and support intermittent renewable sources) through load management and flexibility.[7] While certain elements of natural gas infrastructure may remain essential, electrification (as opposed to investment in renewable natural gas) likely represents the lowest-cost means of achieving California greenhouse gas emission targets for buildings.[8]

In addition, electrification brings significant public health benefits. Indoor combustion of natural gas in appliances like stoves and hot water heaters emits a wide range of pollutants into their surroundings, including carbon monoxide, nitrogen dioxide, particulate matter, and formaldehyde, which can cause asthma and other respiratory illnesses with annual impacts in the billions of dollars.[9] Those who spend large portions of their time indoors at home (an increasingly common reality for many Californians due to COVID-19 or to avoid wildfire smoke) and lack stove ventilation systems (as approximately two thirds of Californians do) are at particularly high risk.[10] Although California has no indoor air quality standards protecting residents' health, replacing natural gas-powered appliances with all-electric models would significantly reduce these harmful indoor gas emissions and improve health outcomes for California residents.[11]

B. ELECTRIFICATION TECHNOLOGY IS AVAILABLE AND COST-EFFECTIVE, BUT FINANCIAL BARRIERS REMAIN

While natural gas infrastructure is pervasive throughout California's residential and commercial buildings, a number of electrified technologies are available that not only reduce climate- and health-harming emissions but also can generate long-term cost savings. These technologies include:

- **Electric heat pumps for space heating and cooling (HVAC)**, which use electricity-powered compressors to move heat into or out of a structure, replacing existing natural gas-fired heaters and less-efficient air conditioning units in a single cost-effective unit.[12]
- **Heat pump water heaters (HPWHs)**, which employ the same technology as heat pump space heating systems to create hot water, are two to three times more efficient than conventional electric resistance water heaters, and are generally cost-competitive with fossil fuel-powered systems.[13]
- **Heat pump clothes dryers**, which are more efficient than traditional natural gas-powered units and consume significantly less electricity than traditional electric resistance models, though they can cost more at purchase.[14]
- **Electric induction stoves**, which use electromagnetic fields to transfer heat to cooking implements at 90 percent efficiency, exceeding both traditional electric resistance and natural gas cooktops by a wide margin, while eliminating indoor kitchen air pollution.[15]
- **Building and appliance load management**, through which electrified heat, hot water, drying, and cooking systems that include grid-responsive technologies and are connected to the grid via smart meters can adjust or time their power consumption to optimize efficiency. These load management applications can maximize grid flexibility, boost reliability, and reduce customer energy costs, particularly for a grid that relies on renewable wind and solar generation.[16]

Despite the increasing availability and long-term cost-effectiveness of these technologies, economic barriers remain. While new all-electric construction saves money by foregoing the often expensive piping infrastructure required

for natural gas installations, retrofitting older buildings with more efficient, all-electric technology may require owners to upgrade their electric panels and wiring, which can prove costly, and some installations may only be cost-effective if multiple appliances need simultaneous replacement.[17] And the nature of energy use in a building will largely determine the extent of benefits. Thus, according to one recent analysis of life-cycle costs, heat pump HVAC can save users up to $550 per year compared to a natural gas combined system, but the technology may cost an additional $200 per year compared to a heat-only system; heat pump water heaters can save users up to $150 per year when installed in new construction, but they may cost just as much as natural gas-powered heaters if installed as a retrofit replacement; and electric induction stoves and clothes dryers currently cost more annually than their gas counterparts.[18] Additionally, while utility rate structures (including some time-of-use rates) can create financial savings for flexible use of electrified appliances, current rate structures may not compensate flexibility enough to match the cost of a retrofit.[19] The high upfront costs of these technologies, coupled with the ancillary work and labor costs of undertaking retrofit work, can exceed many residents' budgets, even though state and utility incentive programs are available.[20] While costs are decreasing for each of these applications, the current state of the consumer economics—particularly for retrofits—highlights the need for greater financial and policy support.

C. LOW-INCOME AND DISADVANTAGED COMMUNITIES HIGHLIGHT ELECTRIFICATION CHALLENGES AND PRIORITIES

Following the legislature's commitment to doubling energy efficiency savings by 2030, the Energy Commission issued a report acknowledging that while building decarbonization for low-income customers and disadvantaged communities is essential to achieving state goals, these Californians are subject to particular challenges in accessing energy efficiency investments.[21] These include structural barriers such as lower access to capital, older buildings, and split incentives between landlords and tenants, as well as policy barriers limiting the success of incentive and outreach programs, each of which can be especially challenging in the context of low-income multifamily housing.[22] Low-income residents are more likely to rent and to live in multifamily housing than higher-income Californians, reducing their ability to invest in electrification—even as lower-income communities are often disproportionately affected by the health impacts of home natural gas use due to smaller, older housing stock and limited ability to maintain and replace older appliances.[23] (Over one quarter of California's homes predate the initial 1978 residential energy efficiency standards, and the vast majority were built before the 2000s, highlighting the challenge posed by the state's older housing stock.[24]) The commission's Clean Energy in Low-Income Multifamily Buildings (CLIMB) Action Plan seeks to address many of these barriers through increased coordination among existing programs and energy agencies.[25]

D. SYSTEM INTEGRITY AND EQUITY CALL FOR A MANAGED TRANSITION

While the climate change- and public health-related necessity of building electrification is becoming increasingly clear, the potential costs and impacts of an unmanaged transition loom large. California's existing natural gas transmission, distribution, and storage system, which serves millions of residential and business customers, consists of billions of dollars of infrastructure funded through investments by the state's gas utilities. While this infrastructure is already built and operating, the utilities are entitled to charge ratepayers to recover the cost of their investments—plus a regulator-approved rate of return—so long as these assets remain "used and useful" by actually providing service that is needed by utility ratepayers.[26] If customers exit the system, however, a utility is still entitled to recover the same cost of investment from the remaining customers, who each pay a higher cost as a result. And if a sufficiently large number of customers exit, assets may no longer be considered "used and useful," leaving the utility unable to recover the full value.[27] Rapid replacement of building natural gas service with electrical service could generate precisely this type of "stranded asset" problem.

A widespread stranded asset problem in California's natural gas system could have especially significant impacts for a particular set of stakeholders. Since higher-income customers are more likely to be able to finance their own electrification projects, they will likely exit the system first—leaving more low-income Californians in the remaining ratepayer pool, even as they are less financially able to shoulder the increased cost burden.[28] As stranded assets are taken out of service and/or reduce utility revenues, thousands of gas distribution system workers in California may suffer job cuts and require employment support and retraining. And declining revenues, gas throughput, and utility workforces could in turn create problems for system maintenance, safety, and reliability, further harming remaining ratepayers and adding risk for workers and residents.[29] While these significant economic and equity concerns do not countermand urgent climate and public health priorities, they do heighten the call for a managed electrification transition.

E. STATE AND LOCAL POLICYMAKERS ACCELERATE THE PUSH

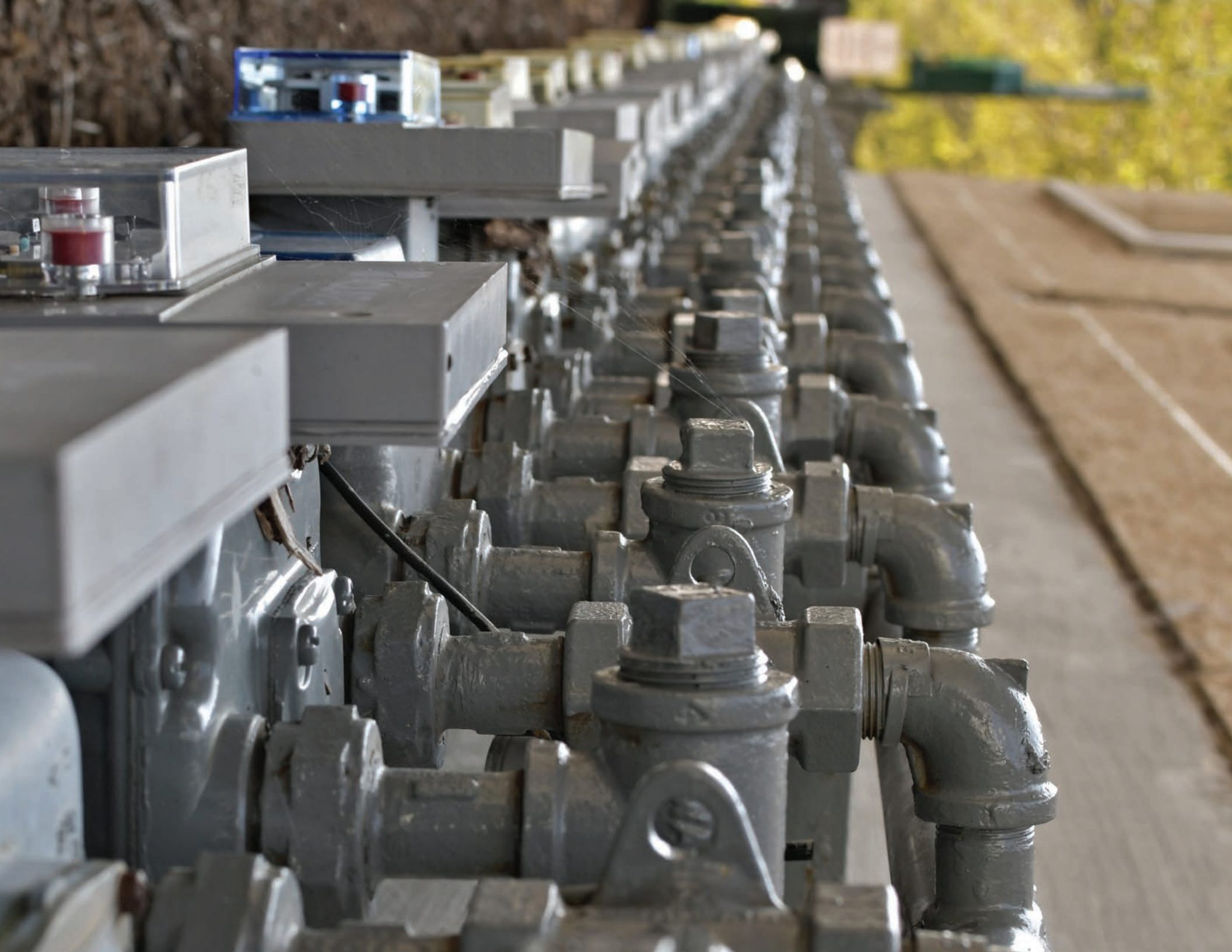
Building on state legislation to decarbonize the electricity sector and reduce emissions from buildings, California state and local government leaders have taken a number of actions specifically focused on building electrification solutions. These include:

- **Senate Bill 1477** (Stern, Chapter 378, Statutes of 2018), which directed the Public Utilities Commission (in consultation with the Energy Commission) to develop two programs deigned to accelerate energy efficiency for low-income Californians:

    - **The BUILD Program**, which requires gas utilities to provide incentives for near-zero emitting technologies in low-income buildings; and
    - **The TECH Initiative**, which requires gas utilities to provide education, training, incentives, and other market development support for new low-emission space and water-heating technologies.[30]

- **The California Energy Commission's Title 24 Building Energy Efficiency Standards**, which the commission updated in 2019 to require rooftop or community solar for all new residential construction, and which many advocates and experts believe should incorporate complete electrification requirements in the 2022 update.[31]
- **Local government electrification measures** ranging from mandatory electrification for all new residential and most nonresidential buildings (e.g., Berkeley), to mandates for new construction with limited exceptions, such as for commercial kitchens (e.g., Santa Cruz), to heightened efficiency standards designed to incentivize but not mandate electrification (e.g., Santa Monica).[32] As of October 2020, over 30 cities and counties in California had adopted new local electrification measures.[33]

The combination of state and local efforts to support building decarbonization reflects a growing push toward electrification and, together with the challenges surrounding stranded assets and system viability, highlights two vital needs. First, state and local leaders need a coordinated process to target electrification investments and policies in communities with the greatest needs and system portions with the highest infrastructure priorities. Second, they need policy and investment support to decarbonize not only new construction but also existing buildings, which present the greatest set of hurdles for electrification.



II.
VISION FOR BUILDING ELECTRIFICATION PRIORITIZATION

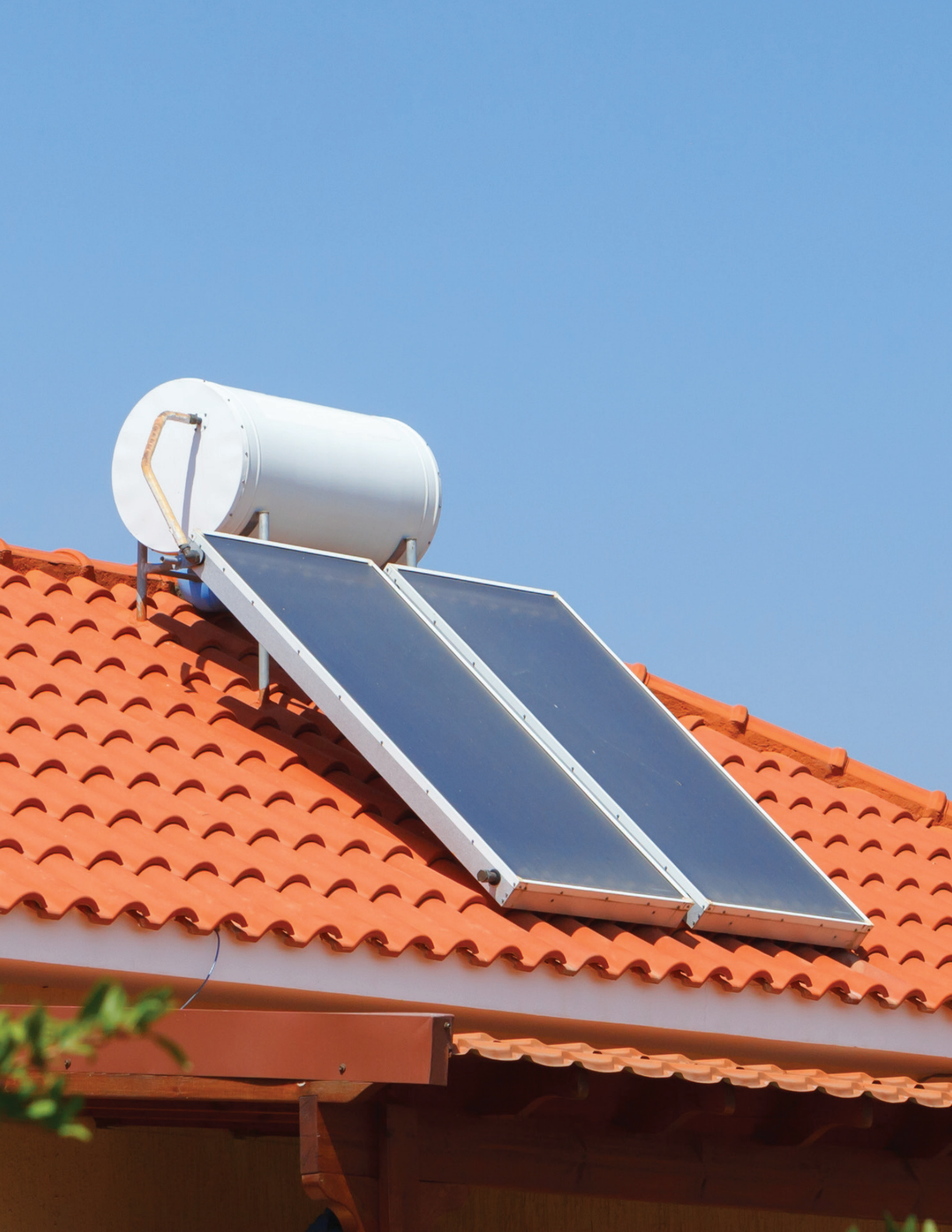
Participants at the September 2020 convening described a vision for a prioritized, structured building electrification transition that optimizes public and private resources across the demands of environmental protection, equity promotion, and economic efficiency. This transition would achieve statewide electrification as fast as possible—by first stopping the expansion of new gas infrastructure and sale of new gas appliances—while maintaining the integrity of the gas system and protecting workers and vulnerable communities. Key elements of the process include:

- **Identification of consensus top priority communities and needs for electrification** that maximize environmental, equity, and economic goals. High-priority areas include:

    1. ***Lower-income and disadvantaged communities*** that are most harmed by the health impacts of natural gas, propane, and wood combustion; have been redlined out of service in the past; and stand to benefit the most from investments in clean, resilient, and affordable technologies. Communities meeting the Public Utilities Commission's definition of "environmental and social justice communities" could potentially fit this description.[34]
    2. ***New construction*** that can rapidly and most affordably avoid installation of new gas infrastructure. This includes residential, commercial, and mixed-use properties (as even a single commercial gas kitchen in a mixed-use development requires full gas distribution infrastructure), and all ownership types.
    3. ***Communities with existing gas infrastructure near the end of its useful life*** that is already in need of near-term replacement, affording an ideal opportunity to electrify while containing ancillary costs and addressing safety and reliability needs. Conversely, infrastructure that recently has been upgraded with public support should be de-prioritized, to maximize the cost-effective use of public funds.
    4. ***Communities that are willing to participate in the transition*** and will generate the least political opposition or delay of critical actions.
    5. ***Communities rebuilding from wildfires*** that require new utility distribution infrastructure to return to service, regardless of type. (The Public Utilities Commission has an ongoing rulemaking that is considering how to incentivize building electrification for new construction in such communities.[35])

- **Coordination of state, local, and utility transitions** to drive active and intentional investment in high-priority, lower-income communities that require public support while facilitating market processes for higher-income communities that can self-finance electrification. This could revolve around an integrated resource planning (IRP) process for building electrification that includes utility leadership to identify cost-effective pathways and union participation to ensure labor transitions.
- **Focus on community-driven processes** that help local community-based organizations (CBOs) and city governments to identify the projects communities most want, facilitate access to state- and utility-provided technical assistance, and communicate with technology and retrofit companies that may not otherwise know which residents to approach. This focus would also ensure that demonstration projects will secure public benefits, include utility bill protections, and avoid experimentation in vulnerable communities.
- **Workforce development** both for those directly displaced by the transition away from gas infrastructure and for residents of low-income communities more broadly, including job training for careers with sustaining wages and clear advancement opportunities, income supplements, and the funding needed to support them.
- **Reform of key state policies** including enhanced enforcement of Title 24 requirements for appliance replacement (to accelerate efficiency gains in existing buildings) and updated utility cost-effectiveness calculations that reflect the full social costs of natural gas and benefits of electrification.
- **Recognition of political barriers and realities**, including resistance to electrified cooking appliances and potential criticism that electrification in communities that experience public safety power shutoffs could increase reliability concerns (although most modern gas appliances rely on electrical components, and many of these communities are adopting their own highly efficient building codes).

This process—coordinated at the state level, reflective of local needs, adaptable to market shifts, and based on an agreed order of priority for investment—could advance state equity and decarbonization goals without sacrificing economic efficiency. But substantial policy support may be needed to convert it to reality.



III.
BARRIERS AND PRIORITY POLICY SOLUTIONS

Participants at the September 2020 convening identified a range of barriers to achieving this vision for a prioritized and coordinated electrification transition, including inconsistent state policies with respect to natural gas, legal requirements regarding maintenance of service, high upfront costs and long payback timelines, workforce transition concerns, and political and cultural resistance to change.

These barriers focused on four central themes:

- **A lack of consistent state policy on electrification** including existing legal and regulatory requirements as well as long-term planning timelines.
- **Political resistance** among gas-only utilities, some labor unions, and other stakeholders invested in the legacy gas system.
- **Stakeholder capacity limitations and resistance** to potentially costly change.
- **Economics and cost profiles** that are not yet sufficiently favorable for all California communities.

This section describes those barriers in detail and highlights the top-priority policy solutions participants identified to overcome them.

A. A LACK OF CONSISTENT STATE POLICY LIMITS THE PACE OF THE TRANSITION

Participants emphasized that while the state legislature and energy regulators have established aggressive greenhouse gas emission reduction targets and long recognized the clear link between achieving those targets and electrifying the building stock, California still lacks clearly aligned state policy supporting a transition to electrification. While laws like AB 3232 and SB 1477 have begun to drive the transition, the state's building energy efficiency codes, utility regulations, and energy efficiency and affordable housing policies have yet to fully embrace it. At the same time, local governments are pressing ahead with phase-out ordinances that will accelerate progress but could also create a patchwork of rules that presents challenges for regional infrastructure planning.

Solution: The Governor could issue an executive order affirmatively declaring that advancing building electrification is a policy priority for the state.

The governor could issue an executive order declaring advancing building electrification to be a California state policy priority, setting a timeline for its achievement and directing agencies including the Energy Commission, Public Utilities Commission, and Air Resources Board to exercise their existing legal authority to the greatest extent possible to carry out the target. The executive order could direct:

- **The Energy Commission** to craft Title 24 building energy efficiency standards that require electrification in new and modified structures;[36]
- **The Public Utilities Commission** to direct gas utilities to accelerate their depreciation schedules for gas infrastructure;[37]
- **The Air Resources Board** to update its Climate Change Scoping Plan to include a formal finding on the timeline of reduction in natural gas use necessary to achieve state climate goals (which could, in turn, inform utility planning processes and state infrastructure and funding decisions); and, together with local air districts, to take action to require electrified appliances in service of both indoor air quality and greenhouse gas emission reduction;[38] and
- **The Strategic Growth Council** to update its Affordable Housing and Sustainable Communities Program (which uses cap-and-trade funds to support housing and transportation developments designed to promote public health and reduce emissions) to require applicants to use fully electrified construction.[39]

While an executive order would not have the same legally binding effect as legislation, it could both spark market action and spur legislation formalizing its principles. California governors have set strong precedent for ambitious climate-related executive orders: for example, a 2018 executive order called for 5 million zero-emission vehicles by 2030, a goal that the state is well in line to achieve; and a 2015 executive order set a greenhouse gas emission reduction target of 40 percent below 1990 levels by 2030, which became state law the following year.[40] And in September 2020, Governor Newsom issued an order calling for a complete phase out of fossil fuel passenger vehicle sales by 2035, together with enabling and supporting actions by the Air Resources Board, Public Utilities Commission, Energy Commission, and other agencies—demonstrating recent willingness to commit to electrification by a date certain.[41] An executive order could set valuable benchmarks for state agencies and advocates alike, while coordinating action through leadership at the head of the state government.

Solution: The state legislature could enact a law setting a clear timeline for the electrification transition.

Participants felt that new legislation setting a clear timeline for electrification of California's building stock, and directing key energy agencies to use their authority to achieve it, ultimately will be essential to rapid and equitable decarbonization. Key energy regulators already have the legal authority to achieve much of the transition, as described above. But a clear legislative mandate could:

- Create a firm, consistent deadline for all agencies to end natural gas in new structures and appliances, followed by a phase-out timeline for existing buildings;
- Affirm regulators' legal authority over existing structures;[42]
- Eliminate legal barriers to reducing gas service, such as the legal obligation to serve (discussed below);[43]
- Build a forum for aligned rulemaking and incentive funding allocation among the Energy Commission, Public Utilities Commission, and Air Resources Board, as well as public involvement through CBOs, labor, and environmental advocates (potentially building on the Energy Commission's existing Integrated Energy Policy Report process); and
- Appropriate new funds and redirect existing funds toward technical assistance, financial support for customers who cannot afford the full costs of a retrofit, and incentives that support all-electric construction.

By setting legally enforceable deadlines for the transition to electrification, such legislation could guarantee a future market for millions of units of electric heating and cooking systems, sparking a market transformation that would substantially reduce upfront costs as has happened for rooftop solar panels and is happening for electric vehicles. It could also help energy regulators make decisions that, while within their current legal authority, are politically controversial. And it could create a state baseline standard for local phase-out ordinances to coordinate with (though legislators would need to ensure that it does not bar or preempt more aggressive local action). Perhaps most importantly, legislation could incorporate enforceable protections for vulnerable communities and appropriate funds to ensure that lower-income customers can afford the transition to electrification without risk of service loss.

Solution: The state legislature could clarify the utility obligation to serve in order to facilitate the transition away from natural gas.

California's utilities are generally required to provide service at standard rates to any customer interested in receiving it as a condition of their right to operate in the state.[44] This "obligation to serve" derives in part from a statutory directive that the Public Utilities Commission require gas utilities to provide basic gas service to all customers, and experts frequently raise it as a barrier to mandatory replacement of gas service with electricity—should a customer call on the obligation to serve, a utility may be legally unable to withdraw gas service.[45] Some dispute exists as to whether the obligation to serve specifically

requires gas fuel or simply requires equivalent energy service, a matter the Public Utilities Commission has not squarely resolved. But participants identified the obligation to serve as a major barrier to rapid electrification, both because of the potential for individual holdout customers to demand maintenance of service regardless of a community's or local government's decision to electrify, and because of utilities' unwillingness to risk legal confrontation.[46] Participants also acknowledged that the legal obligation to serve evolved out of a history of service denial in some lower-income and rural communities, where gas service may be viewed as a hard-won right and may be particularly hard to abandon—and where financial capacity to switch to new electrified appliances may be lowest.

The state legislature could amend the Public Utilities Code to clarify that a utility's obligation to serve relates to energy services—heat, light, and power—and not specifically to natural gas or any other fuel, thus eliminating a potential legal barrier to electrification while still protecting residents' right to essential services.[47] Alternatively, the legislature could allow utilities to offer reasonable compensation in exchange for conversions or consider means to require holdout customers to pay the system-wide cost of maintaining service in communities that are electrifying. Any such solution should recognize that customers' right to service is only as valuable as their ability to access and afford that service, with accompanying policies to mitigate the cost of retrofits and provide appropriate phase-in periods for customers who need financial assistance.

B. POLITICAL RESISTANCE TO TRANSITIONING AWAY FROM THE LEGACY SYSTEM LIMITS STATE PLANNING AND UTILITY INVESTMENT

Participants also highlighted the challenges posed by political resistance to electrification based on the interests of industry and labor groups that have invested significantly in the existing gas system. Fossil fuel companies, gas utilities, and the gas distribution system workforce all have substantial incentive to avert or delay the transition away from natural gas. But given their direct financial stakes, they also stand to benefit from a well managed, deliberate phase-out that offers predictability for investors and retraining for workers.

Solution: The California Energy Commission and Public Utilities Commission could initiate a joint process to identify pathways to financial certainty for the phase-out of existing infrastructure.

As discussed above, the phase-out of natural gas infrastructure by a certain end date could generate a stranded asset problem that might threaten system maintenance and affordability for remaining ratepayers. But it could also jeopardize the financial health of the utilities if they are forced to abandon significant amounts of anticipated revenue, potentially diminishing their long-term ability to raise funds for essential operations. At the same time, stranded assets in a legacy sector could diminish overall investor confidence

in emerging renewable energy and resilience infrastructure, slowing the flow of funds into necessary technologies.[48] To ameliorate these risks, the Energy Commission and Public Utilities Commission could initiate a joint process to identify financial transition pathways—including strategies to reduce the costs of electrification, recover value early through issuance of bonds to cover stranded assets, accelerate depreciation schedules, and even offer state write-offs or financial support—and propose best-fit solutions to create certainty while advancing decarbonization goals.[49]

Solution: The California Labor and Workforce Development Agency could collaborate with labor unions and community-based organizations to craft pathways and establish labor standards for workforce certainty in the electrification transition.

Tens of thousands of Californians are employed in the natural gas distribution sector.[50] Moving away from gas and toward electric service will necessarily involve a transition for many of these well compensated, highly trained and specialized workers over the coming decades. This transition will need to be both just (through retraining programs and support) and certain (based on clear timelines for local and regional infrastructure phase-outs) while supporting essential reliability and maintenance service. While many distribution infrastructure workers are highly experienced and potentially nearing appropriate retirement age, others are new sector entrants with long careers ahead and high potential to retrain.[51]

Participants urged state energy leaders to proactively engage with labor representatives such as the International Brotherhood of Electrical Workers Local 1245 (which represents both gas and electrical workers) and community-based organizations to communicate certain dates for the transition and opportunities for retraining in other infrastructure sectors that offer similar compensation and require comparable levels of technical expertise. Examples include not only the growing electrification field but also carbon capture, biomethane, water and desalination infrastructure, and other areas poised to expand (and potentially offer more job security than the oil and gas sector) in coming decades. Participants cited the Diablo Canyon nuclear power plant decommissioning plan as a potential model for a gas system workforce transition that could meet labor, community, and environmental needs.[52] Key elements of the plan—which utility, labor, environmental, and community stakeholders initially co-developed, and the state legislature ultimately codified—were a phased, multi-year workforce approach with retention bonuses for those near retirement; local retraining for those earlier in their careers; a fund to offset impacts to the local economy; and hundreds of millions of dollars to support these efforts.[53] Participants emphasized that a just transition requires new job opportunities in fields that pay sustaining wages and offer career opportunities (a limitation of some existing weatherization and rooftop solar positions), in addition to income support, wage supplements, and retraining and career counseling.[54] The California Labor and Workforce Development Agency could spearhead a similar collaboration for statewide electrification transition efforts, and the Energy Commission and Public Utilities Commission

could ensure that all transition planning processes incorporate standards and principles developed in that process.

Solution: The California Public Utilities Commission could thoroughly review utility expenditures to ensure that these businesses are not recovering the costs of gas promotion activities through ratepayer funds.

Participants pointed to gas utilities' funding of industry groups formed to promote natural gas and fight electrification, potentially using ratepayer funds.[55] A lack of transparency in these groups' funding sources limits public observers' ability to determine where activities like safety promotion and public engagement on energy efficiency end and lobbying efforts begin, clouding regulators' and advocates' understanding of how ratepayer funds are being used (including potential violations of federal law and past Public Utilities Commission decisions).[56] The commission's Public Advocates Office has already initiated an investigation of some of these expenditures, and in November and December 2020 proposed hundreds of millions of dollars in fines in connection with lobbying activity.[57] But enhanced action (including more stringent investigations, enforcement, and auditing of gas utility expenditures) may be needed to ensure that the costs of promotional advertising and lobbying to encourage gas use are borne by utility shareholders, and to inform the public on the nature of "balanced energy" industry groups.

C. STAKEHOLDER CAPACITY LIMITATIONS AND RESISTANCE TO SHIFTING FUEL SOURCES PREVENT COMMUNITIES FROM REACHING CONSENSUS ON TRANSITION PRIORITIES

A different form of resistance comes from local stakeholders and communities that may be hesitant to transition away from service they currently have. While many of these stakeholders stand to enjoy the long-term financial and health benefits of electrification, some may not be fully aware of the upsides of electrified appliances, and many may not be able to afford the high upfront costs of transitioning without financial assistance. These communities may also be among those that historically were not granted gas service and therefore consider the gas utility obligation to serve a hard-won victory. These important equity concerns highlight the need for robust financial and technical support.

Solution: The state legislature could appropriate funds for the California Energy Commission and California Public Utilities Commission to fund outreach and technical assistance through community-based organizations.

Given public hesitance to shift from gas to electric appliances, the state should ensure funding for trusted local organizations to lead the electrification push

at the local level. This outreach may be especially needed with respect to cooking, where allegiance to gas can run high and where the natural gas industry is actively promoting the legacy technology via social media influencers; and at the intersection of civil rights issues and gas access and affordability.[58]

Community-based organizations can be particularly effective at both conducting outreach to demonstrate the functionality and health benefits of electrification (a role that community choice aggregators have also embraced[59]) and facilitating technical assistance for project installation and financing. These education and capacity-building functions could be essential to drive electrification in the highest-priority communities where resources may be limited. State-supported no-cost technical assistance under the Low-Income Weatherization Program has proven highly valuable in the broader efficiency retrofit context and could be expanded or replicated.[60] In addition, high-profile demonstration projects in key communities (with protections to ensure long-term affordability for lower-income residents) can be helpful to generate public understanding of and interest in electrification, which is far less visible than rooftop solar and electric vehicles. Assembly Bill 2762 (Perea, Chapter 616, Statutes of 2014), which directed the Public Utilities Commission to fund pilot projects to support energy affordability in disadvantaged communities in the San Joaquin Valley, could also serve as a model for legislation.[61]

Solution: The California Public Utilities Commission could direct electric utilities to develop advanced dynamic rates to increase the financial benefits of electrification.

The long-term financial benefits of electrification for consumers can be based in part on the savings and grid benefits that can be generated through the demand-response and load management capacities of advanced electrified appliances. All-electric space heating and cooling systems, water heaters, and clothes dryers, connected to the grid through smart meters, can be set to run at moments when excess power supply is greatest. But consumers will need to see savings on their monthly bills in order to participate.[62] While California electric utilities have recently begun to employ time-of-use billing to encourage off-peak consumption for residential customers (and have long done so for commercial and industrial customers), more dynamic rate structures like real-time pricing (which varies pricing on short intervals and changes daily) could better reward customers for adoption of electrified technologies. The Public Utilities Commission is evaluating whether to require utilities to develop such rates in the future in various contexts.[63] In addition, the commission could support increased access to private aggregation services that allow individual customers to participate and receive compensation for real-time demand response.[64]

Solution: The California Energy Commission, Public Utilities Commission, and Air Resources Board could initiate a public messaging campaign on the benefits of electrification.

The health impacts of natural gas combustion are poorly understood among the public, even as researchers are advancing their understanding of how much indoor

air pollution many Californians suffer on a daily basis. State energy regulators could undertake a public campaign to increase community understanding of the little-known harms Californians are experiencing from their legacy technologies and work with local public health agencies to disseminate the message. This information could be particularly impactful during the COVID-19 pandemic, when Californians are spending more time at home indoors and are more conscious of air quality and respiratory health issues (an issue the Air Resources Board has been increasingly alert to during the record 2020 wildfire season[65]). The public messaging could also help focus on electrification as an improvement of service, rather than a removal or deprivation, and help deliver public cache to the new technology as has developed for rooftop solar and electric vehicles. At the same time, the campaign could address concern around public safety power shutoffs, highlighting the extent to which fully electrified, flexible buildings can help support grid reliability by reducing demand at peak times (including blackout-inducing extreme heat waves like the one experienced in August 2020) and can interact with battery and other distributed storage installations to provide backup power.[66]

D. CHALLENGING ELECTRIFICATION ECONOMICS INCREASE THE NEED FOR PUBLIC FUNDS AND INCENTIVES

The greatest barrier to rapid, prioritized electrification may ultimately be the high upfront costs and long payback periods for investments in electrified technology. Currently, some electrified devices offer clear life-cycle cost savings (in particular heat pump heating and cooling systems), while others may not (for example, induction stoves).[67] These economics are likely to improve significantly in coming years as the technologies mature, but they currently present a challenging case for residents and landlords facing high upfront costs for retrofits and installation. This can be especially true in the high-priority communities identified earlier in this report, where many customers may not be able to afford the full costs of a retrofit and will rely on financial support and phase-in periods to maintain access to critical energy service.

Solution: The state legislature could appropriate short-term funds to help defray the upfront costs of retrofitting and installation for high-priority communities.

While the long-term financial benefits of electrification are likely to increase, the high upfront costs of retrofit and installation work are unlikely to decrease substantially in the short term. Participants felt that state-appropriated (or utility ratepayer-sourced) incentive funds to directly cover part of the upfront costs of installation for qualifying customers in lower-income and disadvantaged communities could be essential to kick-start the electrification market and the managed transition. Participants pointed to the Public Utilities Commission's Self Generation Incentive Program—which recently developed an "equity resilience" budget for low-income and high-fire-risk customers—as a potential model for a short-term equity electrification.[68] Such a program could also help build a

critical mass of electrification projects to bring the retrofit industry closer to cost-competitiveness with the gas industry, which will drive true market transformation.

Solution: The California Public Utilities Commission could incorporate into rates, with equity offsets, all public costs of natural gas' public health, climate, and stranded asset risks.

Participants agreed that while maintaining energy affordability is essential, the state currently underprices natural gas by failing to account for key hidden costs of natural gas combustion and infrastructure. In particular, current gas prices may not fully incorporate:

- Public health impacts of natural gas combustion in indoor environments, which disproportionately impact disadvantaged communities and may exceed billions of dollars per year statewide.[69]
- Upstream greenhouse gas emissions from natural gas production and transmission, including emissions from out-of-state suppliers.
- Stranded asset risks of natural gas infrastructure with investment recovery timelines longer than useful life in an electrification transition.

By failing to incorporate all long-term social costs in the prices consumers pay, gas utilities and regulators effectively afford gas an unearned economic advantage over electricity, which slows consumer adoption of new technologies. To remedy this underpricing, the Public Utilities Commission could:

- Direct gas utilities to assess and include in customer rates the full health cost of indoor natural gas combustion, in coordination with legal requirements to prioritize low-income and disadvantaged communities under Assembly Bill 617 (C. Garcia, Chapter 136, Statutes of 2017) and Senate Bill 350 (De León, Chapter 547, Statutes of 2015).
- Direct gas utilities to include the full upstream climate impacts of their supply chains (including methane leakage, building on Senate Bill 1371 [Leno, Chapter 525, Statutes of 2014]) in customer rates, potentially based on the Air Resources Board's social cost of carbon calculations.[70]
- Require gas utilities to accelerate depreciation schedules for their current infrastructure (front-loading costs while more customers remain in the system) and/or reduce the return on equity for specific assets, and reflect the change in customer rates.[71]

To help mitigate upward pressure on gas bills for low-income customers as a result of these actions, the commission could raise the gas service discount for qualifying customers in the California Alternative Rates for Energy program (currently capped at 20 percent) to match the discount for electric service (30-35 percent).[72] Alternatively, the Public Utilities Commission could update its cost-effectiveness metrics to more appropriately incorporate health and climate impacts;[73] or require utility shareholders to confront some or all of the health and climate costs based on the "polluter pays" principle.[74] Legislation

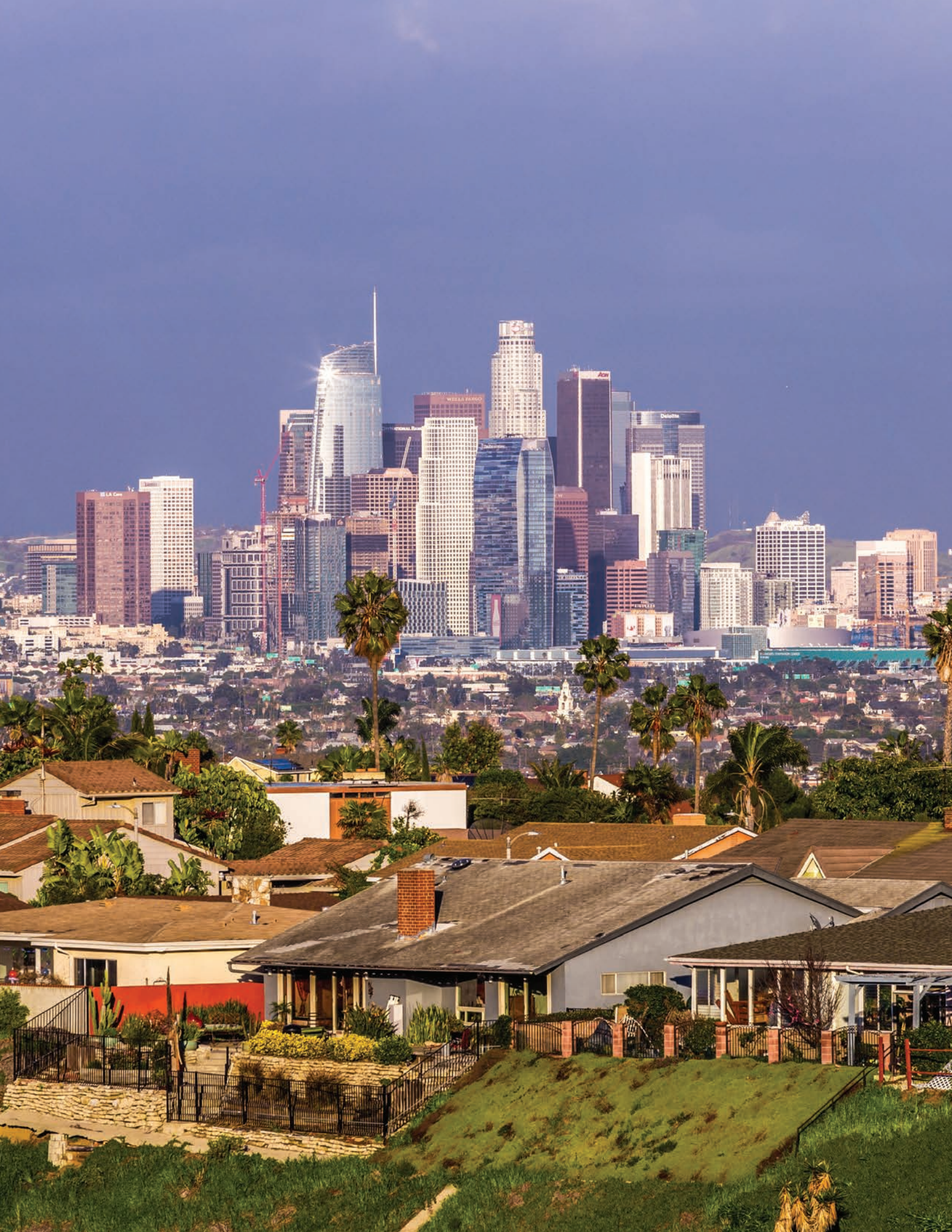
directing the commission to take these actions could accelerate the timeline to achievement and provide legal certainty.

Solution: Utilities could work with customers, retrofit providers, and community-based organizations to identify existing appliances ready for replacement and target them for electrification.

Most customers will not consider upgrading home or business appliances until an existing unit is near its end of life—at which point they need service quickly and may not be prepared to consider a more efficient, higher-cost alternative to their current technology. Advanced smart meter technology can tell utilities (and their customers) when a heating/cooling system, water heater, or even electrical panel is in need of replacement or upgrade, which can serve as a prompt for retrofit and technology providers to engage on an electrification upgrade. Utilities could proactively identify such appliances in smart meter-equipped households/businesses and contact the customers to discuss retrofit and financing options, and with customer permission put them in contact with retrofit providers. They could also support further integration of smart meters in existing structures to facilitate this process. Community-based organizations could serve as a trusted resource to help facilitate contact between utilities and customers. They also could potentially identify preferred local contractors and retrofitters where available. This outreach would naturally identify the high-priority category of infrastructure near the end of its useful life while helping to build a database of older appliances in the state.

CONCLUSION

The urgent need to accelerate building electrification in order to meet California's climate goals also presents a significant opportunity. Prioritizing investment in low-income and disadvantaged communities can reduce indoor air pollution, improve quality of life, and generate long-term savings for vulnerable populations. At the same time, electrifying appliances can increase the flexibility and reliability of an increasingly renewable-powered electrical grid. But the scale of the challenge highlights the need for a managed transition to ensure that financial and technical support goes to the communities that need it; workers are given adequate opportunities to retrain; and the long-term stability and safety of critical infrastructure is maintained. This transition can deliver benefits to high-priority communities, workers, ratepayers, and investors alike.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62 See Sherri Billimoria et al., The Economics of Electrifying Buildings, supra.

63 See, e.g., San Diego Gas & Electric Company, Dynamic Pricing Workshop Report and Summary of Presentations and Participant Comments, A.19-03-002 (October 29, 2019), available at https://www.cpuc.ca.gov/General.aspx?id=6442462894.

64 See, e.g., OhmConnect at https://www.ohmconnect.com/how-it-works.

65 See, e.g., CARB, "Create a #cleanair space at home. HEPA-rated air cleaners can reduce indoor particulate matter by 90%," Twitter (September 30, 2020), available at https://twitter.com/AirResources/status/1311375352111882240.

66 See, e.g., California Independent System Operator, CPUC, and CEC, Preliminary Root Cause Analysis: Mid-August 2020 Heat Storm (October 6, 2020), available at http://www.caiso.com/Documents/Preliminary-Root-Cause-Analysis-Rotating-Outages-August-2020.pdf

67 See Amber Mahone et al., Residential Building Electrification in California, supra, pp. 69-81.

68 See Senate Bill 700 (Wiener, Chapter 839, Statutes of 2018); CPUC, Decision Establishing a Self-Generation Incentive Program Equity Resilience Budget, D.19-09-027 (September 18, 2019) (establishing the equity resilience budget), available at http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M313/K975/313975481.PDF.

69 See Yifang Zhu et al., Effects of Residential Gas Appliances, supra.

70 Cal. Pub. Util. Code §§ 975-978. The use of life-cycle greenhouse gas emissions in calculating carbon intensity for California's Low-Carbon Fuel Standard for transportation fuels, and the statewide emission baseline calculation in New York State's recent Climate Leadership and Community Protection Act, are two prominent examples of accounting for upstream GHG emissions. See 17 Cal. Code Regs. § 95481(a)(88); N.Y. Env. Conservation Law § 75-0105(3).

71 Bilich et al., Managing the Transition, supra, pp. 29-31.

72 See Cal. Pub. Util. Code § 739.1.

73 See Ethan N. Elkind and Ted Lamm, Low Income, High Efficiency, supra, p. 24.

74 See, e.g., Jesse L. Reynolds, "An economic analysis of international environmental rights," International Environmental Agreements: Politics, Law and Economics 19, 557-575 (2019), available at https://link.springer.com/article/10.1007/s10784-019-09454-7.

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