

BUILDING ELECTRIFICATION ACTION PLAN

FOR CLIMATE LEADERS

DECEMBER 2019



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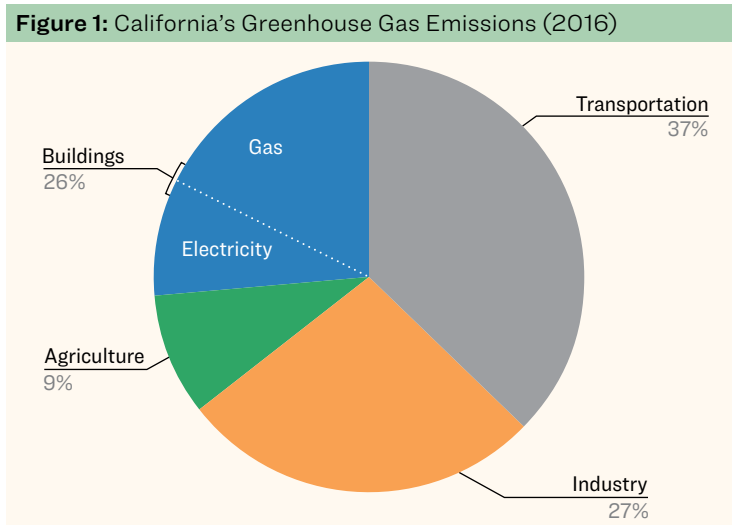
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EXECUTIVE SUMMARY

For too long, the homes and buildings where Californians live and work have been one of the largest sources of climate pollution, accounting for over a quarter of the state’s greenhouse gas (GHG) emissions.¹ To prevent the worst impacts of the climate crisis and avoid increasing inequality and poverty, policymakers must adopt a robust plan to efficiently power and heat the buildings sector with clean electricity and to prioritize low-income communities.

GAS IN CALIFORNIA’S BUILDINGS

Roughly two-thirds of the GHG emissions from California’s buildings come from gas combustion appliances like furnaces, water heaters, and stoves.² Buildings consume more gas than all of the state’s power plants, have an outsized impact on air pollution, and pose unnecessary health and safety risks to communities.³ For example, gas appliances lack modern pollution controls and produce nearly seven times more nitrogen oxide (NOx) emissions than gas power plants, exacerbating Californians’ asthma burden.⁴ Not to mention the upstream pollution from gas drilling: 90% of the gas consumed in California is drilled out of state,⁵ and nationally roughly 70% of gas is fracked.⁶



BENEFICIAL ELECTRIFICATION

Fortunately, years of investment in renewable energy together with technological advances in efficient electric appliances like heat pumps and induction stoves means

that California can bring its dependence on gas to an end. Californians can now turn to local clean energy resources to power everyday activities like cooking, water heating, and space heating with zero emissions. This is commonly referred to as beneficial building electrification.⁷

The climate benefits of electrification are significant. Based on the California Air Resources Board’s 2019 Greenhouse Gas Inventory, building electrification in California would result in an average annual savings of approximately 50 million metric tons of carbon dioxide equivalent (MTCO₂e) through 2045.⁸ However, this estimate does not account for the full impact of methane — a highly potent greenhouse gas — that leaks from the gas system. When full upstream methane leaks are included, the climate benefits of electrification nearly double: roughly 90 million MTCO₂e annual savings on average through 2045, equivalent to taking 20 million cars off the road.⁹ Critically, California’s grid is already clean enough to ensure that electrification would immediately reduce GHG emissions across *all* utility territories. And, of course, the climate benefits of electrification will only increase as the grid progresses toward 100% clean electricity.

The benefits of electrification go well beyond the climate crisis. Electrification can also:

- Lower energy bills by \$4,000–\$10,000 over 20 years.¹⁰
- Reduce cost of building new housing by \$6,000 per single family home and increase speed of construction.¹¹
- Improve air quality and health by reducing hazardous pollutants like nitrogen oxide, carbon monoxide, ultrafine particles, and formaldehydes.

- Create roughly 100,000 new jobs in construction, HVAC installation, electrical work, energy efficiency, and load-management services.¹²
- Improve safety and decrease the risk of gas leaks, fires, and explosions, particularly after earthquakes.
- Improve climate resiliency for Californians, particularly by providing efficient cooling during heat waves.

This Action Plan describes and quantifies these benefits in greater detail and shows why we must ensure that electrification—and its benefits—reach all Californians, especially those in low-income and environmental justice communities.

“RENEWABLE GAS” IS NOT AN ALTERNATIVE TO ELECTRIFICATION

A “combustion solution,” where utilities use biomethane, synthetic gas, or hydrogen gas blended with methane, is not a viable alternative to electrification. Despite the gas industry’s endorsement of this pathway, report after report has concluded that these fuels are not scalable,¹³ have prohibitively high costs,¹⁴ and cause negative environmental and air-quality impacts.¹⁵

POLICIES MUST BOTH ACCELERATE PROGRESS AND FOCUS ON EQUITY

We are already seeing positive market trends toward all-electric buildings across all building types. Builders as well as businesses and homeowners are *choosing* to go all-electric for the affordability, health, safety, and clean energy benefits. Although all-electric construction is certainly on the upswing in California and across the country,¹⁶ it is not yet happening at the speed required by climate science. And despite growing interest in electrification, residents, especially low-income Californians, will face significant hurdles in the absence of new supportive policies. As with other climate policies, equity in building electrification will require direct and targeted policy support.

The next one to five years are the critical window for California’s policymakers to facilitate a managed transition to gas-free buildings and to create a model that is centered on the needs of workers and low-income and environmental justice communities.

At the outset, policymakers should immediately stop expanding the gas system. That requires making all new residential, commercial, and municipal construction all-electric; ensuring that gas appliances in existing buildings are replaced with high-efficiency electric appliances as they

near the end of their lifespan; and providing Californians with incentives to use electric appliances at grid-optimal times, which will reduce GHG emissions and air pollution while lowering costs.

PRIORITIZE LOW-INCOME COMMUNITIES

An equitable and just approach to electrification requires planning for the transition and listening to, prioritizing, and protecting low-income people and environmental justice communities from the outset.¹⁷ Low-income households and environmental justice communities pay a greater price for the state’s dependence on fossil fuels because they face disproportionate levels of air pollution and related illnesses. They are also among the most vulnerable to impacts of the climate crisis, including longer heat waves and colder winters. Despite a desire for clean, energy-efficient homes and a record of hard-hitting advocacy, low-income residents face higher barriers to accessing clean energy and electrification. Absent careful planning and new policies, low-income residents left on the gas system could face untenable rate hikes as gas throughput declines.¹⁸

RECOMMENDATIONS

This Action Plan provides decision-makers and staff in state and local government with a set of near-term policies that will put California solidly on the strategic electrification path — and do so in an equitable and just manner.

We recommend decision-makers across all levels of government enact policies that:

1. **Establish the goal** of a zero-emission buildings sector by no later than 2045, through interim enforceable targets;
2. **Strengthen standards** for buildings and appliances to require zero emissions;
3. **Improve affordability** of electrification with incentives, rate reform, and financing, with a priority focus on low-income residents;
4. **Educate and inspire** consumers and the workforce; and,
5. **Remove roadblocks** and common barriers to electrification, particularly for low-income and environmental justice communities.

The Action Plan that follows describes the challenges and recommends policies for decision-makers across these five broad categories.

SUMMARY OF POLICY RECOMMENDATIONS



1. ESTABLISH THE GOAL: ZERO-EMISSION BUILDINGS NO LATER THAN 2045

Policymakers at all levels of government should adopt a decarbonization goal that aligns with climate science: The buildings sector should achieve zero-emissions no later than 2045 with interim enforceable benchmarks. This is a must have for near-term planning by utilities, appliance manufacturers, builders, and the workforce.



2. STRENGTHEN STANDARDS FOR BUILDINGS AND APPLIANCES

Emission standards are an essential policy tool to ensure that California quickly transitions off fossil fuel appliances, and does so in an equitable manner. Emissions standards can apply to new construction, existing buildings, and appliances.

New Buildings

- **Statewide Building Code (Title 24):** The California Energy Commission (CEC) should create the first statewide zero-emission building code, and end the current favoritism for gas.
- **Local Ordinances:** Cities and counties should adopt ordinances to restrict gas and require or support all-electric new construction for all building types. Dozens of cities have already adopted these ordinances, and more than 50 cities and counties across the state are looking to follow suit.

Existing Buildings

- **GHG performance benchmarking:** State and local policymakers should establish interim GHG performance benchmarks, auditing, and compliance requirements that track with the 2045 zero-emission buildings sector target. California and several cities already have effective energy efficiency benchmarking, auditing requirements, and/or noncompliance fees for large commercial, multifamily, and public buildings. This same concept can and should be adapted to target and reduce GHG emissions in large buildings.
- **Electrification readiness:** State and local policymakers should establish an “electrification readiness” requirement at point of sale or at rental turnover for single-family homes,

small multifamily and commercial buildings. Electrification readiness for electric vehicles is already a measure in California’s green building code (CALGreen) and should be extended to thermal end uses, such as water heating, space heating, cooking, and clothes drying, to make fuel-switching easier when it’s time to replace an appliance.

Appliances

We cannot sell gas appliances after 2030 and expect to meet California’s 2045 climate targets. By regulating at the appliance level, policymakers can tackle all existing buildings, ensure that renters are not the last to benefit from electrification, and provide long-term market certainty for manufacturers, utilities, and the workforce.

- **Air pollution standards for appliances:** The California Air Resources Board (CARB) and California’s Air Quality Management Districts (AQMDs) should phase in zero-emission standards for new appliances to help comply with state and federal air-quality standards. Many AQMDs in California already have nitrogen oxide and carbon monoxide performance standards for long-lived appliances like water heaters and space heaters, but these standards need to be tightened to comply with rapidly approaching Clean Air Act deadlines.

SUMMARY OF POLICY RECOMMENDATIONS, CONT.



3. IMPROVE AFFORDABILITY OF ELECTRIFICATION AND PRIORITIZE LOW-INCOME RESIDENTS

To drive equitable electrification, new policies should lower the initial price as well as the installation and operating costs of advanced electric appliances, with a priority focus on low-income residents.

Prioritize Equity and Access

- **Incentives and rebates:** The California Public Utilities Commission (CPUC) should direct utilities to create fuel-substitution and fuel-switching programs to reduce emissions. The CPUC's cost-effectiveness tests need to be updated to align with GHG reduction goals to make deep efficiency upgrades and electrification scalable. Air Quality Management Districts should also offer greater incentives for electrification to reduce GHG and local air pollution. Cities and counties face tighter budgets, but still have useful leverage points to improve affordability, including expanding bulk buy programs to include heat pumps and induction stoves and creating new revenue streams for electrification incentives by adjusting the utility user tax.
- **Inclusive financing:** Low- or zero-interest financing options are needed to scale electrification, especially for low- and moderate-income residents. This can take many different forms, including on-bill financing. Inclusive financing should be accessible to Californians regardless of income, credit score, rental/ownership status, or language needs.

Reduce Operating Costs

- **Electrification-friendly rates:** the CPUC and all utilities should create an electrification-friendly rate that has a larger tier 1 baseline allowance to reduce the risk of bumping customers who electrify their homes into higher rates. An optional time-of-use rate should be available that reflects the grid needs (duck curve) and the marginal cost of delivering electricity. The off-peak prices should be low enough to send a meaningful price signal to ratepayers and encourage them to set their water heaters to charge when grid electricity is emissions-free, or to use their own rooftop solar electricity rather than send it back to the grid.

Protect Low-Income Households From Rent Hikes and Eviction

- **Tenant protection:** Tenants need protections to ensure that landlords who receive incentives and financial support to electrify and upgrade units do not indiscriminately increase rents, displace or evict tenants. Many examples are available to draw upon, including the federal Weatherization Assistance Program, which conditions funding for building owners on limits to rent increases.

SUMMARY OF POLICY RECOMMENDATIONS, CONT.



4. EDUCATE AND INSPIRE CONSUMERS AND THE WORKFORCE

After decades of gas being the default fuel, there's a significant knowledge gap around all-electric homes and buildings. Residents and the workforce need to understand what's in it for them, including the health, economic, and safety benefits, as well as steps they can take to electrify or to professionally offer electrification services.

Commit to All-Electric Public Buildings

- **Gas-free publicly-owned buildings:** Removing gas from all publicly-owned buildings is an important way to demonstrate and publicize the benefits of electrification while also reducing emissions and supporting market development. Conducting an inventory of publicly owned buildings that identifies facilities that are ready for routine system replacements will help to target and plan for electrification.

Conduct Workforce Outreach, Development, and Training

- **Invest in training programs:** Decision-makers should leverage California's existing workforce training and education system, including state-approved joint labor-management apprenticeship programs and the Community College System. Properly structuring the vast electrification work to include a pathway from apprenticeship programs will create long-term middle-class careers for people facing barriers to quality employment opportunities.

Educate Building Owners and Tenants

- **Education initiatives:** Dispelling the myths about electrification and building familiarity and interest among building owners and tenants is critical. Community education can take many forms, including electrification expos, appliance-lending libraries, and interactive online "how-to" guides. Utilities can play an important role through their advertisements, websites, mail to ratepayers, and education and demonstration centers.

Provide Incentives to Sell, Install, and Service Advanced Electric Appliances

- **Mid and upstream incentives:** The recommendation of contractors, HVAC professionals, electricians, and/or plumbers is a key determinant of what appliances building owners choose to purchase, especially in very common "emergency replacement" scenarios. Targeted upstream and midstream incentives to distributors, contractors, and qualified professionals will both increase sales of advanced electric appliances and move California faster toward a mature heat pump market. State agencies should build upon SB 1477 seed funding and create a more substantial and longer-term incentive program. Attention in program design is needed to ensure low-income households and multifamily buildings in environmental justice communities are served, and that the incentives are conditional upon skill standards and/or responsible contractor criteria.

Launch and Test "Healthy Home" Communities

- **Neighborhood-wide electrification:** The CEC and CPUC should solicit and support innovative pilot programs to begin downsizing the gas system and finding "no pipe" solutions to gas pipeline constraints. In order to determine the most strategic locations for large-scale electrification, the CPUC should require that utilities disclose data on age, safety upgrade needs, leakage, and other factors. Aggregated or neighborhood-wide electrification can simultaneously reduce the cost of operating and maintaining aging gas infrastructure, eliminate local methane leakage, achieve economies of scale, and enforce skill standards that enhance both workmanship and job quality.

SUMMARY OF POLICY RECOMMENDATIONS, CONT.



5. REMOVE COMMON ROADBLOCKS AND BARRIERS TO ELECTRIFICATION

The common set of hurdles faced by home and building owners who want to electrify could ultimately discourage electrification, leading to at least another decade of pollution from new gas appliances.

Streamline and Enforce Permitting

- **Building permit reform:** Building permits must support safety, comply with building codes, and align with larger climate goals. However, permit requirements that further delay, complicate, or add cost to electrification should be reviewed and addressed, as they have in many cities for rooftop solar and EV charging. Permit compliance is also a challenge in California, and could be addressed by a permit-verification process prior to or at the point of sale or new rental permit.

Create a Clearinghouse of Contractors and Professionals

- **Clearinghouse of electrification professionals:**
The CEC or another institution should coordinate one prequalification process that is applied statewide across all load-serving entities. A public clearinghouse of accredited or prequalified professionals should be created that is searchable by services offered and locations served. This will help bridge the information gap between consumers who want to electrify and qualified professionals.

Support Technological Innovation

- **Support R&D for electrification:** The CEC's Electric Program Investment Charge and the CPUC's Emerging Technologies Program should prioritize research, development, and deployment of advanced heat pump technologies that can simplify electrification of California's older and smaller homes. This includes investment in "plug and play" heat pumps that can work on 110V, low-amperage heat pumps that don't require upsizing electrical panels, and heat pumps with smaller footprints.

WE CANNOT AFFORD TO WAIT

The devastating impacts of climate change are already happening: intensifying wildfires, heat waves, droughts, coastal erosion, flooding, landslides, and ecological collapse. As a result, Californians face mounting financial and health burdens, such as the loss of their homes to wildfires and exposure to some of the worst air quality in the country.

The UN Intergovernmental Panel on Climate Change (IPCC) recently determined that we have roughly a decade to dramatically reduce greenhouse gas emissions enough to avoid catastrophic climate change.¹⁹ The IPCC's report and subsequent climate science research create urgency for new policies to develop a rapid, just, and equitable transition from fossil fuels to clean energy.

As the fifth-largest economy in the world and a recognized international leader in climate policy, California must act strategically and quickly to decarbonize the buildings sector, as it is already doing with the electricity sector.

Recent Sierra Club analysis²⁰ and a lengthy set of studies²¹ on building decarbonization have revealed the following important findings, all of which inform the recommendations in this Action Plan.

1. California is not on track to meet its climate goals.

California is not currently on track to transition from gas to clean energy in line with its 2045 carbon-neutrality target. For example, current trends show that, in the absence of any new policy support, electric heat pump water heaters will be installed in fewer than 20% of California's homes by 2050, which is far below what's needed.²² California currently lags behind leading states in heat pump deployment. There are strategic opportunities for policymakers across all levels of government to accelerate electrification and to get California on track to decarbonize the buildings sector in line with climate science.

2. California must electrify new construction and stop building out gas infrastructure. New buildings typically last more than 50 years, and if they are not built with climate neutrality goals in mind, they will become a costly retrofit challenge down the road. Recent studies by Energy and Environmental Economics (E3) find that

delaying all-electric construction would significantly increase the cost for California to reduce GHG emissions, while subjecting more people to gas rate hikes and price volatility.²³ A third of California's buildings in 2045 will be built between now and then²⁴ and should be built to be all-electric and thus achieve zero emissions as the grid becomes cleaner. All-electric construction is less expensive than connecting a home to gas, with average savings of over \$6,000 per home, or \$1,500 per unit in a multifamily building.²⁵ Preparing a home for all-electric appliances in the design and construction phase is not only more cost-effective but also far easier than retrofitting the structure years later.

To achieve California's climate goals at least cost, new construction should be all-electric, and we must begin replacing gas appliances with advanced electric alternatives on die-out.

More than 50 cities and counties are considering requiring or encouraging all-electric new construction with local ordinances and zero-emission reach codes for buildings. The California Energy Commission (CEC) is responsible for updating the state's building energy code (Title 24) every three years and must use this next opportunity to align the building code with the state's climate goals. California cannot afford to keep kicking the proverbial gas can down the road.

3. Fuel-switching existing buildings must begin now to achieve scale by 2030. The best way to minimize the cost of meeting California's climate and air-quality goals is to replace gas and propane equipment with clean electric alternatives at their natural turnover rate.^{26,27} Gas appliances last 10–30 years on average, leaving only one or two natural turnover opportunities for electrification

by 2045. Absent new policies, common hurdles will deter or delay most Californians from fully electrifying their homes, particularly low-income homeowners and renters. The Building Decarbonization Coalition has established these benchmarks for California to achieve its climate goals:

- n Increase the share of high-efficiency heat pumps for space heating from 5% of sales in 2018 to 50% in 2025 and 100% in 2030.

- n Increase the share of high-efficiency heat pumps for water heating from 1% of sales in 2018 to 50% in 2025 and 100% in 2030.²⁸

Policymakers must prioritize policies that both ease and compel fuel-substitution for existing buildings, starting with low-income communities, so that electrification becomes the norm within the next decade.

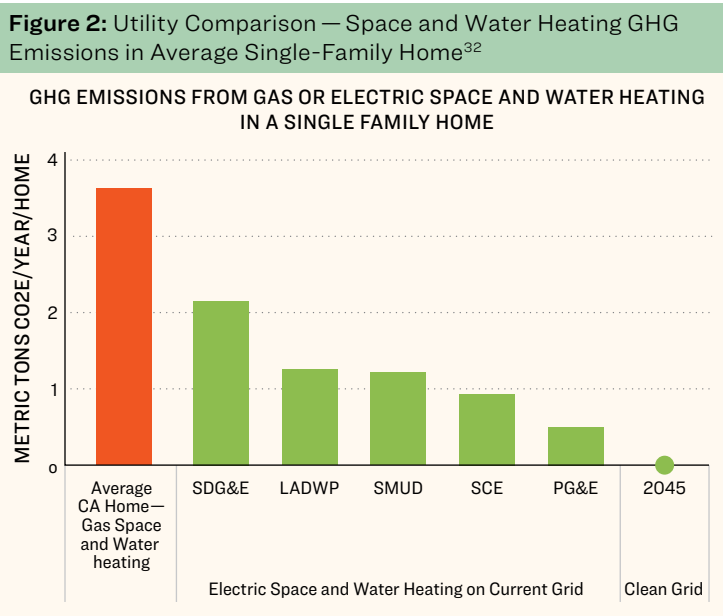


BENEFITS OF ELECTRIFICATION

With appropriate supportive policies in place, building electrification can bring cleaner air, safer communities, greater job growth and economic development, and a more livable climate.

Electrification offers a path to zero-emission, climate-friendly buildings

Advanced electric heat pump appliances are at least three to five times²⁹ more efficient than gas appliances, and induction stoves are twice as efficient as gas stoves.³⁰ High-performing electric technologies in the market today are available to replace *all* gas appliances in residential and commercial buildings.³¹ The superior efficiency of heat pumps means that electrification can immediately reduce emissions in all utility territories, and these climate benefits will only improve as the electricity grid becomes cleaner.



Electrifying residential and commercial buildings by 2045 and powering them with clean energy is expected to result in approximately 90 million MTCO2e of avoided emissions annually.³³

Electrification improves public health

California notoriously has the worst air quality in the country.³⁴ Hazardous air pollution is particularly acute for low-income communities and people of color, who are

exposed to higher incidences of particulate matter (PM 2.5) and other harmful pollutants.³⁵ While most people think of trucks, power plants, and industry as major sources of air pollution, buildings have for too long gotten a free pass.

Household appliances that burn gas, propane, and wood lack modern pollution controls and are a major source of air pollution, particularly in the winter from heating. Gas appliances in residential and commercial buildings in California produce nearly seven times more NOx emissions than do gas power plants.³⁶ Nitrogen oxide is a precursor to ozone and PM 2.5, two pollutants that cause asthma, lung cancer, respiratory diseases, and premature death.³⁷ Electrifying all wood, gas, and propane end uses in residential and commercial buildings was recently determined to deliver the *largest* potential primary PM 2.5 emission reductions compared with other sectors of the economy.³⁸ Since 90% of Californians live in counties with failing grades for ozone or particulate pollution, electrification is essential for all residents and a necessary step for the state to comply with federal ambient air-quality standards.³⁹

Electrification reduces GHGs emissions in all utility territories today. For the average house using a gas water heater and a gas furnace, electrification today can cut related household emissions nearly 50-75%. The climate benefits of electrification will only increase as utilities continue to make progress decarbonizing their grids to be zero-carbon by 2045.

Electrification will also immediately improve indoor air quality. On average Californians spend nearly 70% of their time indoors, making indoor air quality a key determinant of human health.⁴⁰ The combustion of gas inside homes produces harmful indoor air pollution, specifically nitrogen



During a typical week in winter, an estimated 12 million Californians are exposed to nitrogen dioxide (NO₂) levels, and 1.7 million are exposed to carbon monoxide levels that exceed state and national air-quality standards due to the use of gas cooking appliances in their homes.⁴¹

dioxide, carbon monoxide, nitric oxide, formaldehyde, acetaldehyde, and ultrafine particles.⁴² These odorless and undetectable gas-combustion pollutants can cause respiratory diseases as well as more serious conditions, including death.⁴³

The science is clear on how hazardous gas combustion is to our health. Lawrence Berkeley National Laboratory recently found that air pollution levels in the 60% of homes that have gas stoves exceeded the US EPA's definition of clean air, meaning that the air pollution in these homes would be illegal if found outdoors.⁴⁴ Another study found that women who use gas stoves had a higher risk of asthma attacks and reduced lung function.⁴⁵ And, another study found that children living in a home with a gas stove have a 42% increased risk asthma.⁴⁶ This is a particularly acute issue for smaller homes with less ventilation and for children and the elderly, who are more susceptible to respiratory illnesses. These air pollution induced health impacts have direct ties to economic well-being, as they are linked with increased school and work absenteeism and higher medical bills.

Electrification replaces fracked gas with clean energy

California imports 90% of its gas from out of state,⁴⁷ over 70% of which is fracked.⁴⁸ All-electric homes and buildings

drastically reduce the demand for fracked gas, while extending the reach of clean energy resources into homes. Electric appliances, especially water heaters, space heaters, and clothes dryers, can be programmed to operate when the sun or wind is generating electricity. For example, a heat pump water heater can preheat water in the middle of the day, when California's electric grid is rich in solar power, and store that hot water for use during the following 24 hours. This will help take advantage of the abundant renewable energy on the grid or electricity from rooftop and community solar, further supporting the state's ability to achieve its renewable energy goals.

Electrification creates new employment opportunities

Transitioning California's 14 million homes and over 8 billion square feet of commercial buildings off of gas will create new employment opportunities for the state's growing workforce. We expect new jobs in construction, including HVAC installation, electrical work, and energy efficiency, as well as in load-management services. A study by UCLA estimates that electrifying California's homes and buildings would create roughly 100,000 new jobs. Supporting California's workforce will be vital to a successful transition from gas to clean energy buildings. New policies can help

Electrification can create roughly 100,000 new jobs in construction, including electrical, plumbing, HVAC, and efficiency work, as well as from new investment in manufacturing in California.



to ensure that electrification increases demand for skilled workers and creates family-sustaining jobs, while minimizing displacement of gas workers.

Electrification improves safety

Accidents in Aliso Canyon (2015/16), Bakersfield (2015), Carmel (2014), San Bruno (2010), and Rancho Cordova (2008), as well as the recent fires in North Carolina, Massachusetts, and San Francisco, are unfortunate reminders of the gas system's inherent risks. On average, over the past five years, every four days a gas pipeline incident killed someone, sent someone to the hospital, and/or caused a fire and/or explosion.⁴⁹ A strategic and managed transition off gas can mitigate safety risks from California's aging gas system, including:

- n Gas leaks and fires after earthquakes:** Communities with gas pipelines in earthquake-prone areas face an increased risk of fire, since vibration and changes in pipeline tension during seismic events can cause gas leaks. Aging pipelines and associated equipment and inflexible pipeline materials are particularly vulnerable. The California Seismic Safety Commission estimates that up to half of post-earthquake fires are related to gas leaks.⁵⁰
- n Gas system vulnerability to climate change:** More than 150,000 miles of gas pipeline⁵¹ crisscross California. The California Energy Commission warns that much of California's gas system—particularly pipelines along the state's waterways and coasts—is vulnerable to climate-change impacts like sea level rise, storms, flooding, and associated erosion.^{52, 53}
- n Fires from everyday methane leaks:** The state's aging gas system is leakier than previously estimated—not just at the transmission level but along distribution pipelines and even inside homes and buildings. The Sierra Club's review of methane leakage research shows that 2.3% to upward of 4.5% of the methane in the gas system leaks before it even reaches homes and buildings.⁵⁴ Adding to this, some portion of gas that comes through the residential and commercial gas meter leaks *inside* our homes, schools, restaurants, and buildings.⁵⁵ Methane leakage is a serious safety risk, as it can cause fires that lead to injuries or death.⁵⁶
- n Gas fires and explosions from third-party contractors:** Perhaps the most common cause of pipeline ignition is when a private contractor strikes gas infrastructure with earthmoving or other equipment. Although utilities spend millions of dollars every year in education and outreach, and operate

In 2017, California gas utilities lost over six billion cubic feet of methane into the air from the gas system, costing California ratepayers over \$18 million annually. This is more spilled gas every year than the entire Aliso Canyon blowout of 2015 and 2016, which is considered the single worst gas leak in US history.⁵⁷

a call-in number so third parties can notify them before they dig, several gas line strikes happen every year, some of which ignite with deadly results (San Francisco, 2019). As long as explosive material is running through a vast network of underground pipes, this problem cannot be eliminated with outreach and training alone.

n Explosions and fires from over-pressurization:

Over-pressurization of gas mains can cause dangerous explosions resulting in fire, destruction of homes and entire communities, injuries, and fatalities. While these events are typically caused by human error, they nonetheless occur regularly and should not be tolerated. Aging gas pipelines are vulnerable to over-pressurization and are also very costly to replace at approximately \$1 million per mile.⁵⁸ A pressure surge in a gas pipeline that exceeds the maximum set pressure can result in a catastrophic loss of integrity and potential explosion, as seen in San Bruno, California, (2010) and Andover, Massachusetts (2018).

Electrifying entire communities, particularly where there is aging or vulnerable gas infrastructure should be a key strategy to mitigate the growing safety risks of California's massive gas system.

Electrification supports affordability

Californians face an escalating housing crisis where rents and home prices are out of reach for most working families, particularly low-income. Existing low-income housing stock is old and a prime candidate for investment,⁵⁹ housing roughly a third of Californians. California needs to do more both to support new affordable housing and to invest in improving the current low-income housing. While comprehensive policy reform is needed to make sure Californians have safe, stable, and affordable housing, efficiency upgrades and electrification should be part of the solution.

All-electric new construction and efficiency upgrades paired with electrification of existing buildings can reduce the cost of building new housing, lower utility bills for occupants, and shield customers from the volatile and rapidly increasing costs of gas. For these economic benefits to reach those



Electrification can help make housing more affordable by avoiding costly new gas infrastructure for new buildings, lowering energy bills with super-efficient electric appliances, and shielding residents and businesses from the quickly escalating costs of gas.

most in need, electrification policies and programs should begin with customers in low-income and environmental justice communities, who are eager to overcome historic barriers to clean energy.

n Electrification lowers the cost of new housing

construction: It's estimated that building all-electric in California would reduce construction costs on average by over \$6,000 per single family house, or \$1,500 per multifamily unit, by eliminating the costs of piping gas inside the building.⁶⁰ All-electric homes are also faster to build given their ability to avoid gas pipeline permitting and installation. Mixed-fuel buildings can take weeks to months longer to build than all-electric designs. Affordable-housing developers who build all-electric can use the project savings to provide enhanced services for tenants or to fund additional projects, thus stretching the benefits for low-income tenants.

n Electrification lowers utility bills: Lowering total energy bills is essential for low-income residents, who spend a disproportionate amount of their income on energy. Californians with incomes below 50% of the federal poverty level spend 20% to 30% of their monthly income on home energy bills.⁶¹ Between 19% and 25% of California families face energy insecurity, and thousands of families face disconnections from utility services because they are not able to afford their energy bills.⁶² And, nationally, utility bills are among the top reasons why people resort to predatory payday loans.⁶³ Electrification, particularly when paired with energy-efficiency improvements and solar power, can lower monthly utility bills for ratepayers. Tenants and homeowners can see utility bill savings of up to \$800 annually.⁶⁴ While rate reform in most utility territories will be essential for ratepayers to realize significant savings (with bill protections needed for the most vulnerable households), residents in several low-income housing developments are already seeing reductions in monthly utility bills after efficiency and electrification upgrades.⁶⁵

n Electrification protects ratepayers from volatile and rising gas rates:

Electrification also shields ratepayers from the volatile and rising price of gas. Gas infrastructure costs account for 80% of what Californians pay for gas, and gas bills are becoming more expensive owing to the massive infrastructure upgrade investments currently being made by gas utilities.⁶⁶ Recently, for example, Pacific Gas and Electric⁶⁷ and Southern California Gas Company⁶⁸ respectively requested 15% and 30% (or 24% and 42% nominal) gas revenue increases from ratepayers by 2022. At the same time, decreasing gas use owing to energy efficiency and a warming climate means that the cost per unit of gas is already increasing and expected to continue doing so over the coming decades. If California does nothing to facilitate a managed transition off gas, the consulting firm Energy + Environmental Economics (E3) predicts that gas rates will rise from under \$1.50/therm today to more than \$19/therm (in today's dollars).⁶⁹

Low-income ratepayers are particularly vulnerable to these gas rate hikes, as renters cannot control the appliance fuel choices made by landlords, and low-income homeowners do not have the capital for upgrades to replace old gas appliances with electric. It is essential that new electrification measures begin by making fuel-switching accessible and affordable to low-income residents, both so they get priority access to affordable clean energy and so they won't be forced to shoulder the rising costs of California's gas system.

Electrification supports grid flexibility

Programmable or grid-connected electric appliances are an untapped grid-flexibility resource in California that can both lower energy bills and integrate more clean energy onto California's electricity grid. With the right policies in place, heat pump water heaters could provide low-cost energy storage and reduce reliance on gas power plants to provide

this load-following service. Utilities across the country, including Sacramento Municipal Utility District in California, rural cooperatives in Washington, and utilities in the Pacific Northwest and Florida, already have electric water heater demand management pilot programs.⁷⁰

Electrification improves climate resiliency and comfort

California is experiencing an increase in extreme summer heat waves.⁷¹ Many Californians, particularly low-income families, do not have air-conditioning and are unprepared to adapt to spiking temperatures, which poses new health and safety risks. As the climate warms, Californians are expected to add low efficiency portable A/Cs or window A/Cs. It would be better for the grid and consumer's energy

bills to have that cooling delivered by high efficiency A/Cs than cheap and inefficient equipment.

Air-conditioning is an important bonus from replacing gas furnaces with electric heat pump space heaters, as the heat pumps can operate in reverse to provide very high-efficiency and easily controllable cooling. Electrification offers greater comfort, safety, and climate resiliency when temperatures peak.

Heat pumps also offer superior performance for heating homes in the winter. They provide steady and easily controllable heat, rather than the sporadic blasts of hot air from central gas furnaces or bad odors and smoke from gas wall furnaces. This makes heat pumps the technology of choice in higher-end homes today.

ELECTRIFICATION AND POWER OUTAGES

In the midst of unprecedented power shutoffs, climate resiliency is top of mind for many Californians. Here are some FAQs.

Q: Given the electric power shutoffs, don't we need gas for reliability?

A: No. Most modern gas appliances like gas tankless ("on-demand") water heaters, furnaces, dryers, and ovens require electricity to operate. Gas appliances are even more vulnerable to outages than electric appliances since gas appliances depend on two functioning infrastructure systems. Electric appliances, on the other hand, can be combined with microgrids, rooftop solar, and storage, to operate without the electricity grid's power supply. The storage tank in an electric heat pump water heater also allows for the delivery of hot water for roughly 24 hours after the electricity goes out.

Q: What about gas system outages?

A: The California Energy Commission warns that much of California's gas system — particularly pipelines along the state's waterways and coasts — is vulnerable to climate threats and natural disasters, including sea level rise, storms, flooding, and erosion. Gas service can also be shut off due to limited pipeline capacity or gas supply, planned maintenance activities, wildfires, and unplanned maintenance from leaking or damaged pipes and malfunctioning pressure regulators. After a shutoff, the

gas system takes much longer to restore than the electric system. For example, after an earthquake it takes about 3 days to restore electricity to most customers, whereas it can take nearly 3 months to restore gas service to that same portion of customers.⁷² After the Kincadee wildfires, communities in Sonoma County had their electricity service restored days to weeks before gas service was restored. This is because gas utility workers must visit each customer's home or business, inspect the gas meter for leaks, and clear lines of residual gas before restoring service and re-lighting pilot lights on gas-powered appliances.

Q: How can utilities be part of the solution?

A: In addition to ending the use of fossil fuels, like gas, that make climate change and wildfires worse, and hardening the electric grid — utilities should be directed to invest in microgrids and other local clean energy solutions that increase resilient, reliable, and clean power. One recent example is East Bay Clean Energy's project with SunRun to install rooftop solar panels and batteries at low-income homes in the East Bay. This will provide electricity to low-income homes if the grid goes down, while enhancing the day to day reliability of the grid.

“RENEWABLE GAS” IS NOT A VIABLE ALTERNATIVE TO ELECTRIFICATION

Ensuring healthy air for all and a stable climate requires phasing out gas. Yet faced with the reality of declining sales and California’s mandate for a carbon-free future, some gas utilities and gas providers are fighting tooth and nail to retain and even expand their customer base.

To preserve its market share, the gas industry is attempting to distract policymakers from true clean energy solutions by touting the pipe dream of “renewable gas.” If the industry succeeds in delaying the inevitable transition off gas with its promise of “renewable gas,” it will dramatically increase costs for Californians and lock in decades of damaging climate emissions.

SoCal Gas and its industry front group Californians for Balanced Energy Solutions are promoting an unrealistic

Biomethane and synthetic methane are not a viable alternative to building electrification. At most, they could replace up to 10% of current gas use in California buildings, leaving no supply for carbon-intensive sectors that are harder to electrify.

decarbonization strategy at state and local government agencies based on biomethane, synthetic gas, and hydrogen as an alternative to building electrification.⁷³ Under their combustion-based decarbonization scenario, a limited amount of biomethane,

synthetic gas, or hydrogen would be piped through the gas system alongside fossil gas, and “renewable gas” credits would be purchased from states thousands of miles away. Residents and businesses would continue using combustion-based appliances, though at higher operating costs, and face ongoing exposure to air pollution, safety risks, and the rising costs of the gas system, while thinking they are buying a clean “green” product.

California must reduce fugitive methane emissions from sources like landfills and dairies, but commoditizing this pollution is not an effective way to address it. Relying upon these methane sources to heat homes and buildings is

not feasible, as the volume of fuel available from landfills and dairies is an order of magnitude lower than the gas demand in buildings. Given the limited supply and scalability, prohibitively high cost, and potential for *creating* methane and having harmful environmental and air-quality impacts, biomethane, synthetic gas, and hydrogen are not a realistic alternative to building electrification and must be strategically reserved for sectors that are more difficult to electrify.⁷⁴

What is “renewable gas”?

“Renewable gas” refers to non-fossil sources of methane—mainly biomethane, synthetic methane, and hydrogen gas—that can be piped through the gas system.

1. **Biomethane** can be derived from organic waste feedstocks, such as manure from dairy farms, landfill gas, and gas from wastewater treatment plants. Methane that would otherwise have escaped into the atmosphere is captured and processed so that it can be used to displace fossil methane gas. **Biomethane production can be problematic for several reasons:**
 - n Biomethane feedstocks from agricultural and forestry residue would typically otherwise be composted and therefore decompose aerobically, creating no methane. Turning these wastes into methane *creates* methane where none would have existed.
 - n Energy crop feedstocks require that agricultural land be devoted to growing energy crops. That means either converting agricultural land currently used for food crops or creating new agricultural land for energy crops from forests or other landscapes.
 - n Biomethane development from dairy farms requires concentrating cattle herds in a single area to make gathering the manure cost-effective. Cattle emissions could alternatively be reduced through better manure

management practices. Additionally, anaerobic digestion has been shown to increase ammonia emissions by 81%.⁷⁵

2. Synthetic methane is made by electrolysis and methanation. In this process, electricity is used to split water into oxygen and hydrogen gas. The hydrogen gas is then combined with carbon to become a methane gas, or synthetic methane. This process is commonly referred to as “power-to-gas.”⁷⁶ **The limitations of synthetic methane include:**

- n The production of synthetic methane is highly inefficient (approximately 54% efficient). Even assuming a power-to-gas facility is optimized to use surplus renewable energy, the power-to-gas process would transform zero-emissions energy into a highly potent global warming pollutant that is subject to leakage.
- n Leaving the inefficiencies and methane leakage risk aside, power-to-gas technology is still in an early stage of development. It is considered a “reach technology,” is very costly, and has not been identified as a dependable technology for state-wide deployment.⁷⁷

3. Hydrogen gas can be created by electrolysis which, as previously described, splits water into oxygen and hydrogen. **Hydrogen gas is also not a silver bullet:**

- n Although hydrogen can be made with renewable electricity, roughly 95% of hydrogen production today relies on fossil fuels.⁷⁸
- n Hydrogen gas cannot be directly piped into the gas system without combining it with methane gas. A UC Davis study for the California Air Resources Board concluded that the gas system can tolerate mixtures with up to 10% hydrogen, noting that regulators need to verify the safety, as hydrogen poses significant risks of embrittlement, leakage, and flammability.⁷⁹ Thus, the “hydrogen solution” is really a misnomer. In reality, a substantial amount of the fuel burned in homes would still be methane, with only a marginal portion being hydrogen.
- n Hydrogen also faces major cost, efficiency, and technical challenges that limit its potential as a scalable building decarbonization strategy.

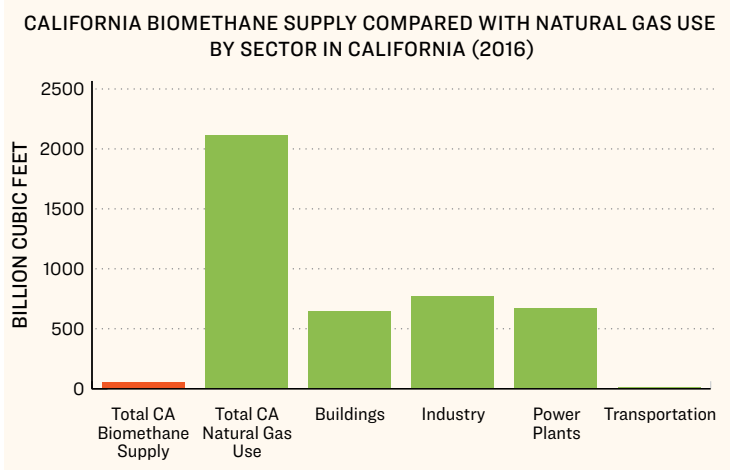
Biomethane supply is limited and not scalable

Although California has one of the largest potential supplies of biomethane in the country⁸⁰ it is nowhere near large enough to justify forestalling building electrification. At best, sustainable sources of biomethane from California’s waste could replace only 2.5% of the state’s total gas consumption.⁸¹ Even if California’s total potential supply of biomethane were used exclusively for buildings and not for

electricity generation, industry, or transportation, it could replace no more than 10% of gas demand from buildings statewide (see Figure 3).⁸² More-ambitious estimates of biomethane supply include out-of-state sources, and non-sustainable in-state sources that would actually *add* methane to the environment, such as from crops grown for energy consumption.⁸³

To get around the indisputable physical limits of biomethane supply in California, SoCal Gas often inflates the potential biomethane supply before policymakers and the public by relying on potential estimates that include unsustainable biomethane sources like agricultural and forestry wastes and energy crops.⁸⁴

Figure 3: California biomethane supply insufficient to replace gas use.⁸⁵



Biomethane credits are not sound climate policy

An often overlooked cornerstone of SoCal Gas’s initiative to decarbonize buildings with “renewable gas,” is the assumption that the utility can procure biomethane *credits* from across the country, regardless of whether the gas will or even can be delivered to customers in California. Relying on paper transactions for biomethane produced thousands of miles away from California presents resource shuffling and accountability problems⁸⁶ and means the gas in California’s pipeline system would still be predominantly fracked fossil gas. Moreover, much of this biogas would have been captured anyway, whether the credit was sold or not, so buying the credit would have little or no GHG reduction impact. Lastly, a key objective of California’s climate strategy is that it be scalable as a model for other states and countries. Requiring California to commandeer more than its population-weighted average share of national biomethane potential⁸⁷ would leave insufficient biomethane supply for other states, which means the strategy is not a scalable or replicable model.

Biomethane, synthetic gas, and hydrogen are prohibitively expensive

Using biomethane, synthetic gas, and hydrogen to decarbonize buildings is prohibitively expensive and cannot compete with electrification. Existing dairy biomethane projects in California depend on research and development funds, subsidies, and funding from the Low Carbon Fuel Standards program. Biomethane would be particularly costly, as it would require a considerable build-out of the gas system to interconnect disparate sources of methane from dairies and landfills, in addition to capturing and processing the gas.

In analysis for the California Energy Commission, E3 posits that biomethane, synthetic gas, and hydrogen as a carbon abatement strategy could cost California over \$1,000 per MTCO₂e avoided.⁸⁸ This is orders of magnitude more expensive than investing in energy efficiency, heat pumps, and renewable electricity. E3 concludes that the “High Electrification Scenario appears to be lower cost and with less dependence on reach technologies.”⁸⁹ According to E3, achieving 80% greenhouse gas reductions by decarbonizing the gas grid would have economy-wide costs between \$5 and \$20 billion dollars *more* than achieving the same reductions through the electrification of buildings.⁹⁰

Even the controversial analysis by SoCal Gas/Navigant, which inflates the costs and underestimates the GHG benefits of electrification, finds that biomethane sourced in California would cost *more* than electrification. As a result their analysis concludes that for biomethane to replace less than half of the gas used by its residential customers, the utility would need to rely upon 75% to 100% of biomethane being produced out of state (i.e., paper credits).⁹¹

Biomethane and synthetic gas have negative environmental, safety, and air-quality impacts

There are inherent environmental justice concerns with making biomethane a primary fuel source, including

entrenching reliance on gas from landfills and dairies located in environmental justice communities and exacerbating air and water pollution.

- n **Producing biomethane harms nearby communities. Biomethane production relies upon capturing methane from dairies and landfills.** Dairies and landfills are significant sources of air and water pollution, including nitrate pollution in groundwater, ammonia gasses, and fine particles, which lead to and exacerbate respiratory problems like asthma.⁹² Landfills and dairies are often located in or near environmental justice communities.⁹³
- n **Injecting biomethane and synthetic gas in pipelines entails the same safety risks as the fossil gas system, including methane leakage, over-pressurization, and fires.** The risk of accidents like those in San Bruno and Aliso Canyon is the same whether biomethane, synthetic gas, or fossil gas is used as a fuel source. Similarly, as California faces increasing risks of earthquakes and wildfires, it is essential that the state pivot away from all sources of methane that could exacerbate disasters, rather than further expand the footprint of the gas system.
- n **Biomethane and synthetic gas in household appliances release the same hazardous air pollutants that fracked fossil gas does.** Upon combustion, biomethane and synthetic gas release nitrogen dioxide, carbon monoxide, nitric oxide, formaldehyde, acetaldehyde, and ultrafine particles, all of which are harmful to human health.

While it is critical to curb short-lived climate pollutants like methane emissions from dairies and landfills, the strategy for doing so cannot include creating a dependency that locks in those emissions as a new fuel source for millions of buildings across the state. Instead, we must reduce the quantity of methane created in the first place, through sustainable dairy practices, zero-waste policies, and waste diversion.



There are inherent environmental justice concerns with making biomethane a primary fuel source, including entrenching reliance on gas from landfills and dairies located in environmental justice communities and exacerbating air and water pollution.

COMMON HURDLES TO ELECTRIFICATION

Despite the benefits of electrification, transitioning off gas will not necessarily be easy for many Californians, and this is especially true for low-income residents and for renters who are dependent on landlords to replace gas appliances. While the need to electrify and the benefits of a clean energy transition are clear, ditching fossil fuels in California's 14 million homes will not occur equitably without policy intervention. The hurdles are surmountable, though, with leadership at all levels of government.

Regulatory hurdles

Although state and local agencies support beneficial electrification and are making progress to untangle decades of policies that have favored gas, many historic policy hurdles to electrification remain and require prompt reform.⁹⁴

California aims to reduce GHG emissions 40% by 2030 and to be carbon neutral by 2045, but the state has not yet extended these goals to the most polluting sectors of the economy, including buildings. Therefore, California's energy policies do not align with its climate goals, which reduces its chances of successfully cutting emissions. For example:

- Despite important progress in the last code cycle for low-rise residential buildings, the California Energy Commission's Title 24 building code still favors using gas for water and space heating in new, large multifamily and commercial buildings, which makes it challenging to build all-electric. We cannot afford to keep expanding the gas system with new buildings that will require expensive retrofitting to be all-electric and zero-emission in a decade or two—nor to lock in emissions for decades to come.
- Utility programs are not currently optimized to reduce greenhouse gas emissions in homes and buildings. Reforming the California Public Utilities Commission (CPUC) fuel substitution test was a big step forward, and new building-decarbonization incentive programs from SB 1477 also are being developed. However, a more comprehensive effort to align utility programs and policies with California's decarbonization goals is still needed. This will require updating metrics (particularly cost-effectiveness metrics) and focusing more explicitly on emissions.

- Gas subsidies paid for by ratepayers, such as gas-line extensions and measures that encourage customers to buy new gas appliances, must be reevaluated. The builders of new private developments should be responsible for the cost of their own gas infrastructure if they are going to build it, not ratepayers.
- Electricity and gas rates often do not reflect California's decarbonization and grid needs and could disadvantage ratepayers who electrify end uses by bumping them into more costly tiers. Energy rates should encourage Californians to use clean electricity (not gas) and reduce emissions.
- State-funded programs for affordable housing, school construction, health-care centers, and state buildings should not expand the gas network. State funding should support all-electric new construction and retrofits to achieve zero-emissions.
- Appliance emission standards are currently outdated and do not protect consumers and families from hazardous indoor air pollution, thereby keeping polluting gas appliances on the market and in our homes and businesses.

Failing to clear these regulatory hurdles could cause Californians to keep old habits—purchasing new gas appliances and expanding the gas system with new construction. The result would be to lock in decades of emissions and add to the cost of transitioning off gas, while also sending the wrong market signal to manufacturers and the building trades.



WHAT ABOUT ELECTRIC COOKING?

Induction cooking is gaining popularity among professional and home chefs. *Consumer Reports* ranked induction models as its top two stoves in 2018. People prefer induction stoves and convection ovens for their superior precision, responsiveness, speed, and safety compared with gas.

Lack of customer awareness and workforce familiarity

Californians are generally unaware of the benefits of clean electric technologies like heat pumps and induction stoves, which is not surprising given their limited deployment across the state. Lack of consumer awareness is a difficult challenge to overcome because consumers do not typically think about their heating appliances as long they are in good working condition. Space and water heaters are usually installed in out-of-the-way locations — literally out of sight and out of mind. Most purchases of space and water heating equipment are made as emergency replacements when existing equipment fails. Unlike with planned replacements, customers in an emergency replacement situation do not have time to investigate new technology options. In the absence of policy support, emergency replacement purchases will often be similar gas equipment.

Customers typically rely on contractors and HVAC professionals to recommend replacement equipment, especially in time-constrained emergency replacement situations. However, professionals are less likely to recommend electrification options if they are not familiar with the technology or comfortable installing and servicing the equipment. Building professionals need more education about electrification technology. Policies that include upstream incentives and certification can make electrification more valuable to these professionals and help overcome this hurdle. Local building departments also need education and training. Without outreach and training, they often provide misinformation, i.e. that electrification is “not allowed.”

Upfront costs

Californians who might want to replace polluting gas appliances with clean electric alternatives often do not have the capital to make the switch in these early days

of electrification. While the equipment costs of efficient electric appliances are cost-competitive with gas appliances, and in some cases less expensive,⁹⁵ electrical upgrades can be a cost barrier for home and building owners. While not all homes require electrical upgrades, those that do face added costs to upsize the electrical panel and/or run electrical conduit to the new appliances. Electrification incentives and rebates can lower these upfront costs, and done right, can spur workforce development. New lower-amperage “plug and play” products are also less likely to require electrical upgrades. Costs will come down over time, but policy support is needed to help customers, particularly those with limited incomes, upgrade old and unsafe electrical panels.

Low-income residents left behind

Low-income Californians face significant barriers to accessing clean energy resources, making them often the last to benefit from clean technologies like rooftop solar, electric vehicles, energy efficiency, and advanced electric appliances. Low-income tenants have little to no ability to procure clean energy resources like energy efficiency upgrades, rooftop solar, or advanced electric appliances and, given California’s housing shortage, making housing decisions based on access to clean energy is not an option.

Low-income residents have been left behind by the clean energy market and require policymaker intervention. Landlords typically do not invest in efficiency or clean energy upgrades because they do not reap the ongoing utility bill, health, and comfort benefits. This age old “split incentive” problem will need to be overcome with policy intervention and new programs to compel landlords to upgrade and electrify apartment buildings, without passing all the costs onto tenants. Relying solely on the market to solve the problem ignores the decades of neglect of low-income housing.

Low-income Californians who own homes also face financial and structural barriers to clean energy. They typically live in



CPUC Commissioner Martha Guzman Aceves with San Joaquin Valley residents from Tulare, Ducor, and Alpaugh, and environmental justice advocates from The Greenlining Institute and Self-Help Enterprises after the CPUC approved \$56 million for electrification pilot projects serving 11 low-income communities. This environmental justice and community-led proceeding will result in pilot programs to increase access to affordable and renewable energy for 1,600 households that will no longer need to rely on expensive and polluting propane and wood burning to stay warm, to cook, and to heat water. The energy-efficiency and electrification upgrades are expected to lower household energy bills by \$150 per month and nearly \$2,000 per year.

older buildings, do not have sufficient access to capital, and are located in remote or underserved communities.

Policies to accelerate building electrification must be designed to increase access for these low-income renters and homeowners from the start. This means helping consumers transition to electric not just from gas but also from propane and wood burning. Incentives, rate reform, community education, and other electrification programs should be designed with low-income and environmental justice organizations at the table for planning, monitoring, and evaluation.

Environmental justice advocates have launched an equitable building electrification initiative, led by The Greenlining Institute in partnership with Energy Efficiency for All. Their recent publication *Equitable Building Electrification: A Framework for Powering Resilient Communities* describes the steps policymakers must take to ensure that

electrification brings low-income communities access to clean energy and energy security,⁹⁶ including:

- 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.**

Applying the equitable building electrification framework to policymaking, with environmental justice and community leaders working side-by-side, will be essential if California wants healthy homes, quality jobs, clean air, and a stable climate.

ACTION PLAN

Gas appliances are bad for our health and an obstacle to meeting climate objectives. The technology exists today to replace them, but outdated policies give preference to fossil fuels. Comprehensive policy reform is needed.

This Action Plan lists the steps that decision-makers must take to overcome electrification hurdles, equitably electrify buildings, and help save the planet.

Decision-makers should:

- 1. Establish the goal** of a zero-emission buildings sector no later than 2045 with interim enforceable targets;
- 2. Strengthen standards** for buildings and appliances to require zero emissions;
- 3. Improve affordability** of electrification through incentives, rate reform, and financing, with a priority focus on low-income residents;
- 4. Educate and inspire** consumers and the workforce; and,
- 5. Remove roadblocks** and common barriers to electrification, particularly for low-income and environmental justice communities.

Given the scale of the problem and the limited time available to make this clean energy transition, no single policy approach alone will be enough.⁹⁷ To ensure that homes and building are electrified both equitably and expeditiously, decision-makers must employ a mix of mandates, incentives, and education. The following are foundational policies to achieve this goal.

1. ESTABLISH THE GOAL: ZERO-EMISSION BUILDINGS NO LATER THAN 2045

Policymakers at all levels of government should adopt a decarbonization goal that aligns with climate science: The buildings sector should achieve zero emissions no later than 2045 with interim enforceable benchmarks.

Building decarbonization goals can be adopted at the local level through city and county climate action plan updates or local ordinances, and at the state level through executive orders, legislation, the California Air Resources Board's GHG Scoping Plan, and the CEC/CPUC's Proceeding on Building Decarbonization.

Building decarbonization targets need to be set early on, as they will subsequently drive policy reform and program development. Setting these targets will also provide much needed clarity for utilities, appliance manufacturers, builders, and the workforce. Just as regulatory agencies have adopted procurement targets for zero-emission vehicles, renewable energy, and energy storage, establishing goals for the buildings sector will encourage stakeholders to develop the innovative technologies and services needed.



The city of Carlsbad (San Diego County) became the first in California to require heat pump water heaters or solar thermal for new low-rise residential construction. Months later, the city of Berkeley (city council pictured at left) became the first in the U.S. to prohibit gas hookups for new residential and commercial construction. More than 50 cities and counties in California are considering local action to require or incentivize new construction to be all-electric.

2. STRENGTHEN STANDARDS
FOR BUILDINGS AND APPLIANCES

Emission standards are an essential policy tool to ensure that California quickly transitions off fossil fuel appliances. Emissions standards can apply to new construction, existing buildings, and appliances.

New Zero-Emission Buildings

The gas industry connects one new home or building to gas every minute of the day, totaling 565,831 new gas connections annually in the US.⁹⁸ In the last five years, California added more gas connections than any other state.⁹⁹ We must reverse this trend, and all-electric or zero-emission building codes and local ordinances are a clear first step.

The California Energy Commission should create the first statewide zero-emission building code in the Building Energy Efficiency Standards (Title 24) 2022 code cycle. To ensure that forthcoming building code update align with the state’s climate goals, the CEC should use an electric baseline for code compliance, use GHG savings as a primary metric for code compliance, include gas infrastructure costs in cost-effectiveness tests, and appropriately value grid-interactive and/or programmable electric appliances. In the short-term, the CEC should update the Alternative Compliance Manual so high-efficiency all-electric buildings can comply with the 2019 building code via the performance pathway.

Cities and counties should adopt ordinances to restrict gas in new construction. A zero-emission buildings “reach code”¹⁰⁰ would require or support the use of advanced electric appliances like heat pump water heaters and heat pump space heaters over gas for any new construction. Similarly, cities and counties can adopt a local ordinance prohibiting gas infrastructure in new buildings, where the

city can show that local climatic, geologic, or topographic conditions require it to go beyond the state building code. More than 50 cities and counties across the state are looking to phase out gas in new construction.

At the time of publication, over twenty cities passed gas bans or electrification ordinances. For the most up-to-date summary on new California city and county requirements for new zero-emission buildings, see our blog.¹⁰¹

Existing Buildings

Existing buildings are more challenging to electrify than new construction, but doing so is a nonnegotiable for the climate, safety, and health of communities.

One useful strategy for existing buildings is to develop interim GHG benchmarks, auditing, and compliance requirements that align with the 2045 target for zero-emission buildings. California and several cities, including Los Angeles, San Francisco, and Berkeley, already have energy efficiency benchmarking, auditing requirements, and/or noncompliance fees for large commercial, multifamily, and public buildings. These are typically targeted at buildings 10,000 square feet or larger. The benchmarking requirements have led building owners to track and ultimately improve energy efficiency. This same concept can be adapted to target and reduce GHG emissions in large buildings.

An “electrification readiness” requirement at point of sale or at rental turnover may be more suitable for single-family homes and small multifamily and commercial buildings. Electrification readiness for electric vehicles is already a measure in California’s green building code (CALGreen). This same “electrification readiness” concept can be applied to thermal end uses, such as water heating, space heating, cooking, and clothes drying, to make fuel-switching easier when it’s time to replace an appliance. Electrification readiness can entail upsizing a panel and/or bringing electrical conduit to the appliances, with clear signage indicating the circuit space or electric conduit is reserved for a heat pump or induction stove.

Appliances

We cannot sell gas appliances after 2030 and expect to meet California’s 2045 climate targets.

The California Air Resources Board and California’s Air Quality Management Districts (AQMDs) should phase in zero-emission standards for new appliances to help comply with state and federal air-quality standards. Many AQMDs in California have nitrogen oxide and carbon monoxide performance standards for long-lived appliances like water

Examples of local governments supporting electrification	
Carlsbad	Prohibits gas in new residential water heating. Requires heat pump water heating or solar thermal.
Berkeley	Prohibits gas hookups in new construction, with a few exemptions.
San Luis Obispo	Encourages all-electric new construction. New buildings with gas must be “electrification ready,” meet more stringent energy savings requirements, and pay a one-time fee which will fund electrification retrofits.
Windsor	Requires all-electric construction for residential buildings under four stories.
San Jose	Requires all-electric new construction for new residential buildings (under four stories) and new municipal buildings. Establishes a timeline for extending this to high-rise residential and commercial buildings. Encourages all-electric new construction for high-rise residential and commercial buildings. New buildings with gas must be “electrification ready” and meet more stringent energy savings requirements.

heaters and space heaters.¹⁰² With Clean Air Act deadlines rapidly approaching, these appliance standards need to be tightened and adopted across California.

By adopting standards that phase in zero-emission performance for major appliances like water and space heaters, CARB and the AQMDs would go a long way toward improving local air quality, while also providing long-term market certainty for manufacturers of advanced electric appliances and the workforce. By regulating at the appliance level, policymakers can ensure that renters are not the last to benefit from electrification.

3. IMPROVE AFFORDABILITY OF ELECTRIFICATION AND PRIORITIZE LOW-INCOME RESIDENTS

For building electrification to be equitable and to scale, advanced electric appliances need to be affordable for all Californians. To drive beneficial electrification and transform the market, new policies should lower the initial price of advanced electric appliances, as well as the installation and operating costs, with a priority focus on low-income residents. We must adhere to lessons learned from developing the rooftop solar and EV market in California—invest deeply and ensure access for low-income customers from the start.

Prioritize Equity and Access

Incentives are needed to lower the cost of purchasing and installing advanced electric appliances like heat pumps and induction stoves, particularly for low-income customers.

We've seen how incentive programs can help transform new markets. For example, the CPUC's California Solar Initiative helped deliver nearly one million solar roofs, lower solar panel prices, and develop new financing models.¹⁰³

Despite this success in making solar accessible to moderate-income Californians, recent analysis¹⁰⁴ finds that solar

penetration still lags in low-income and environmental justice communities. This underscores the need for initiatives designed to help low-income residents of single-family and multifamily homes, like the new Low-Income Weatherization Program (LIWP) and Solar on Multifamily Affordable Housing (SOMAH). We must learn from the successes and challenges of the rooftop solar movement as we craft the next wave of California's electrification policies.

The California Public Utilities Commission has several existing sources of funding that it should direct to new electrification incentives, including SB 1477 (\$50 million/year), Energy Efficiency, Energy Savings Assistance Program, and the Self-Generation Incentive Program. To improve air quality and public health, utilities must offer incentives for switching to electric, not just from gas but also from polluting and costly wood and propane heat. Ultimately, the CPUC should *direct* utilities to create fuel-substitution and fuel-switching programs to reduce emissions. Reforming the Three-Prong Fuel Substitution Test was a good first step, but updating the energy efficiency program's cost-effectiveness tests to align with GHG reduction goals will be necessary to make energy efficiency funding available for deep efficiency upgrades and extensive electrification measures.

Investor-owned utilities (IOUs), community choice aggregation (CCA) programs, and municipal utilities should use energy-efficiency funding, low-income energy-efficiency budgets, plus other funding sources like R&D budgets, private financing, and Air Quality Management District grants to establish electrification incentive programs that help Californians and especially low-income residents. IOUs and CCAs are no longer restricted by the CPUC's Three-Prong Fuel Substitution Test, and have a new opening to be electrification leaders like the Sacramento Municipal Utility District (SMUD)(see text box).



Sacramento Municipal Utility District (SMUD) offers electrification rebates worth up to \$5,000 for new homes and up to \$13,750 for existing homes that convert from gas to electricity.

Building-electrification incentive programs should also leverage the growing popularity of rooftop solar and EVs. Finding innovative ways to pair electrification with new solar installations, new EV-charging infrastructure, storage, and/or energy efficiency upgrades will open up a larger consumer base for building electrification. Pairing building electrification with energy efficiency and solar will also lower energy bills and shorten solar payback periods, support appropriately sized and managed systems, and potentially make the clean energy project more profitable for the contractor or installer.

Air Quality Management Districts can reduce local emissions by awarding climate and air-quality mitigation grants to local governments, utilities, or third parties to administer as regional electrification incentives. AQMDs can also directly offer incentives to support deployment of zero-emission appliances, as they've already done to discourage and phase out polluting wood stoves. Through a public process with community and stakeholder engagement, AQMDs should create new incentive programs explicitly to help low-income and environmental justice communities reduce local emissions and electrify.

Cities and counties face tighter budgets to support electrification but still have useful leverage points they can use to improve affordability and access for residents and local businesses. Local governments can expand bulk buy programs¹⁰⁵ to include heat pumps and induction stoves. Local governments can also create new revenue streams to use for electrification incentives by adjusting the utility user tax. Increasing the utility user tax¹⁰⁶ for gas can generate new city revenue to help residents and business owners electrify. Through a public process with community input, cities should develop new incentive programs that prioritize residents most in need and hardest to reach—low-income homeowners and renters.

Reduce Operating Costs

For electrification to both scale and be powered by clean electricity, we need energy rates that make electrification affordable and that better reflect system costs. A new optional “electrification-friendly rate” would encourage customers to electrify thermal loads and operate electric appliances during times when plenty of renewable energy is on the grid. Current load-shifting technologies can enable programming appliances to turn on/off and up/down when desired, as well as be grid-interactive. For example, batteries and electric water heaters can be charged during the middle of the day when solar energy is abundant, storing this renewable energy for later use.

While the benefits to the grid of electrification and load-shifting are clear, policies that encourage it would also lower energy bills for all Californians, which is especially important for low-income residents. It would also encourage the use of renewable energy — not gas plants — to power and heat homes, thereby improving local air quality, particularly for environmental justice communities next door to gas power plants.

As a first step, the **California Public Utilities Commission and utilities (IOUs, munis, and CCAs)** should create an electrification-friendly rate that has a larger tier 1 baseline allowance to reduce the risk of bumping customers who electrify their homes into higher rates. An optional time-of-use rate should be available that reflects the duck curve and the marginal cost of delivering electricity. The off-peak prices should be low enough to send a meaningful price signal to ratepayers and encourage them to set their batteries and water heaters to charge when grid electricity is emissions-free, or to use their own rooftop solar electricity rather than send it back to the grid.¹⁰⁷

Protect Low-Income Households From Rent Hikes and Eviction

Tenants need protections to ensure that landlords who receive incentives and financial support to electrify do not indiscriminately increase rents. As highlighted in the Equitable Electrification Framework, there is concern about rent increases, displacement, and eviction connected to efficiency upgrades and electrification. Policymakers should work with the housing and environmental community to develop the right local protections for tenants. Many examples are available to draw upon, including the federal Weatherization Assistance Program, which conditions funding for building owners on limits to rent increases.

Inclusive Financing

Many Californians, especially low-income residents, do not have easy access to low- or zero-interest financing options to help them afford electrification and efficiency improvements. While rebates and rate reform will help, inclusive and accessible financing is essential to scale zero-emission buildings across the state. This can take many different forms, including on-bill financing.¹⁰⁸ Inclusive financing should be accessible to Californians regardless of income, credit score, rental status, or language needs. Including low-income Californians in the design process can help to ensure an inclusive financing program that is accessible and useful.



The University of California has committed to fossil-free, all-electric buildings. No new UC buildings or major renovations, except in special circumstances, will combust fossil fuels like gas, for space and water heating.

4. EDUCATE AND INSPIRE CONSUMERS AND THE WORKFORCE

After decades of gas being its default fuel, California now has a real need to educate residents, building owners, and the workforce on fuel-switching and all-electric buildings. Residents, business owners, and the workforce will need to understand what's in it for them, including the health, economic, and safety benefits, as well as steps they can take to electrify or to professionally offer electrification services.

Commit to All-Electric Public Buildings

The state, as well as its cities, and counties, can lead by example by developing and implementing a plan to remove all gas in publicly owned buildings. This is an important way to demonstrate and publicize the benefits of electrification while also reducing emissions and supporting market development. Conducting an inventory of publicly owned buildings that identifies facilities that are ready for routine system replacements will help to target and plan for electrification.

Conduct Workforce Outreach, Development, and Training

Electrification will create local jobs and workforce development opportunities. Decision-makers should leverage California's existing workforce training and

education system, including state-approved joint labor-management apprenticeship programs and the Community College System. Properly structuring the vast electrification work to include a pathway from apprenticeship programs will create long-term middle-class careers for people facing barriers to quality employment opportunities. Existing apprenticeship programs can provide local residents the training to not only do this work safely and effectively but also perform other important decarbonization-related work such as installing and maintaining energy storage systems, microgrids, and electric vehicle charging stations.

Educate Building Owners and Tenants

More education and outreach are needed to build familiarity and interest among building owners and tenants. Education and outreach should convey the benefits of electrification, outline technology options, and provide resources on where to begin, such as lists of certified contractors and available rebates. Community education can take many forms, including electrification expos, appliance-lending libraries, and interactive online "how-to" guides. Utilities and community choice aggregation programs can play an important role through their advertisements, websites, mail to ratepayers, and education and demonstration centers.

Sonoma Clean Power's outreach, demonstrations, and induction stove lending program led to 90% of people who borrowed an induction stove being interested in buying one instead of a gas stove.



Provide Incentives to Sell, Install, and Service Advanced Electric Appliances

Most replacement purchases of furnaces, water heaters, and air conditioners happen when the current appliance stops working. Because this leaves little time for research, the recommendation of the general contractor, HVAC professional, electrician, or plumber who will do the installation has an outsized impact. That makes it essential both to motivate professionals to recommend this equipment and to have distributors stock heat pumps to prevent delay.

Providing targeted upstream and midstream incentives to distributors, contractors, and qualified professionals will both increase sales of advanced electric appliances and move California faster toward a mature heat pump market.

SB 1477 will provide \$200 million over four years for builders, developers, and appliance manufacturers, distributors, and installers to deploy low- and zero-emission water heaters and space heaters in new and existing buildings. While this is a start, state agencies need to create a more substantial and longer-term incentive program to scale deployment of clean electric appliances. Such a program will also need to effectively target low-income households and multifamily buildings, particularly in environmental justice communities. New upstream and midstream incentives should be conditional upon skill standards and/or responsible contractor criteria to attract high-performing contractors, ensure work quality, and prevent wage and labor law violations common in the residential-construction market.

Launch and Test “Healthy Home” Communities

Another building decarbonization strategy is to focus on aggregated or neighborhood-wide electrification opportunities. This approach can simultaneously reduce the cost of operating and maintaining gas infrastructure, eliminate local methane leakage, achieve economies of scale, and enforce skill standards that enhance both workmanship and job quality. Mechanical, electrical, and plumbing professional skill requirements are critical to ensure the safety and efficacy of a gas decommissioning and electrification project.

Over the long term, electrifying neighborhoods may cost less than maintaining and repairing existing gas infrastructure, particularly in areas where the gas system is aging or at capacity. Situations where expensive gas infrastructure investments can be redirected to electrification are

compelling opportunities to transition to clean energy and mitigate the health and safety risks from gas infrastructure, particularly in earthquake-prone areas.

This approach to electrification is already gaining attention in the Northeast and is a fertile area for innovative approaches by utilities and other third parties in California. Community benefit agreements can be used to help ensure local, veteran, minority, and disadvantaged hiring occurs on construction projects.

Research by Energy and Environmental Economics finds that to achieve climate goals and protect ratepayers a managed decline of the gas system must be geographically targeted. E3 posits that a managed transition with targeted electrification (i.e., where entire sections of the gas system are decommissioned) would save roughly \$25 billion (net present value).¹⁰⁹ In addition, such an intentional and managed transition would protect gas workers and ensure electrification services for low-income communities and renters.

The California Energy Commission and California Public Utility Commission

should solicit and support innovative pilot programs to begin downsizing the gas system and finding “no pipe” solutions to gas pipeline constraints. In order to determine the most strategic locations for large-scale electrification, the CPUC should require that utilities disclose data on age, safety upgrade needs, leakage, and other factors.

5. REMOVE COMMON ROADBLOCKS AND BARRIERS TO ELECTRIFICATION

When home and building owners try to replace gas appliances with electric, they face a common set of hurdles: costly or confusing permitting requirements, difficulty finding contractors and HVAC professionals familiar with electrification, and sometimes physical constraints that make heat pump installation more challenging. Left unaddressed, these bumps in the road could discourage home and building owners from electrifying, leading to another decade or two of emissions from new gas appliances. The recommendations that follow should help overcome these challenges.

Streamline and Enforce Permitting

Building permits must support safety, comply with building codes, and align with larger climate goals. However, permit requirements that further delay, complicate, or add cost to electrification should be reviewed and addressed, as they

have in many cities for rooftop solar and EV charging. Permit compliance is also a challenge in California. The city of Davis enforces permitting through a permit-verification process prior to or at the point of sale. A rental-permit inspection program that looks for permit compliance is also an option for larger multifamily buildings.

Create a Clearinghouse of Contractors and Professionals

To help bridge the information gap between consumers who want to electrify their homes and businesses and qualified professionals, a public clearinghouse of accredited and prequalified contractors and mechanical (HVAC), electrical, and pipe trade professionals is needed. Prequalifying contractors and mechanical, electrical, and pipe professionals will also expedite the rollout of future electrification incentives and rebates.

The **California Energy Commission** or another institution should coordinate one prequalification process that is applied statewide across all load-serving entities. A public clearinghouse of accredited or prequalified professionals should be created that is searchable by services offered and location served.

CONCLUSION

As Californians face intensifying wildfires, longer heat waves, and persistent air pollution, the need to transition off of fossil fuels is only becoming more and more urgent. This reality paired with the rising costs of the gas system and the billions of dollars in savings that will result from winding down this system, point to the need to start planning and electrifying now.

Strategic planning for a managed and equitable transition from gas to clean energy in our homes can achieve three critical objectives: (1) ensure California deeply cuts emissions in time; (2) create “high road” jobs and support workers impacted by the transition, and (3) prioritize and protect low-income residents so they can be among the first to benefit from clean energy.

California has the experts, skilled workforce, public support, and supportive utilities needed to make this transition both successful and a model for other states and countries. The biggest mistake policymakers can make is to delay

Support Technological Innovation

Although many residential and commercial buildings are relatively straightforward to electrify today, some building types have installation constraints such as insufficient electrical panels, the need for 240V wiring, or limited space for electric heat pump equipment. Supporting technological innovation by funding research, development, demonstration, and deployment will help manufacturers find long-term solutions for California’s housing stock needs. For example, developing and deploying:

- n “Plug and play” heat pumps that can work on 110V
- n Low-amperage heat pumps that don’t require upsizing electrical panels
- n Heat pumps with smaller footprints.

The **CEC’s Electric Program Investment Charge** and the **CPUC’s Emerging Technologies Program** should prioritize research, development, and deployment of these innovative heat pump technologies, all of which would simplify electrification of older and smaller homes.

action — to keep expanding the gas system when all the science points to the need to move in the opposite direction.

We urge policymakers at every level of government to lead on equitable climate and clean energy solutions. By advancing policies that move communities to all-electric homes and buildings, decision-makers will build important political momentum for change, immediately slash climate pollution, as well as improve the air quality, safety and resiliency in the communities they serve. The time to act, and electrify, is now.

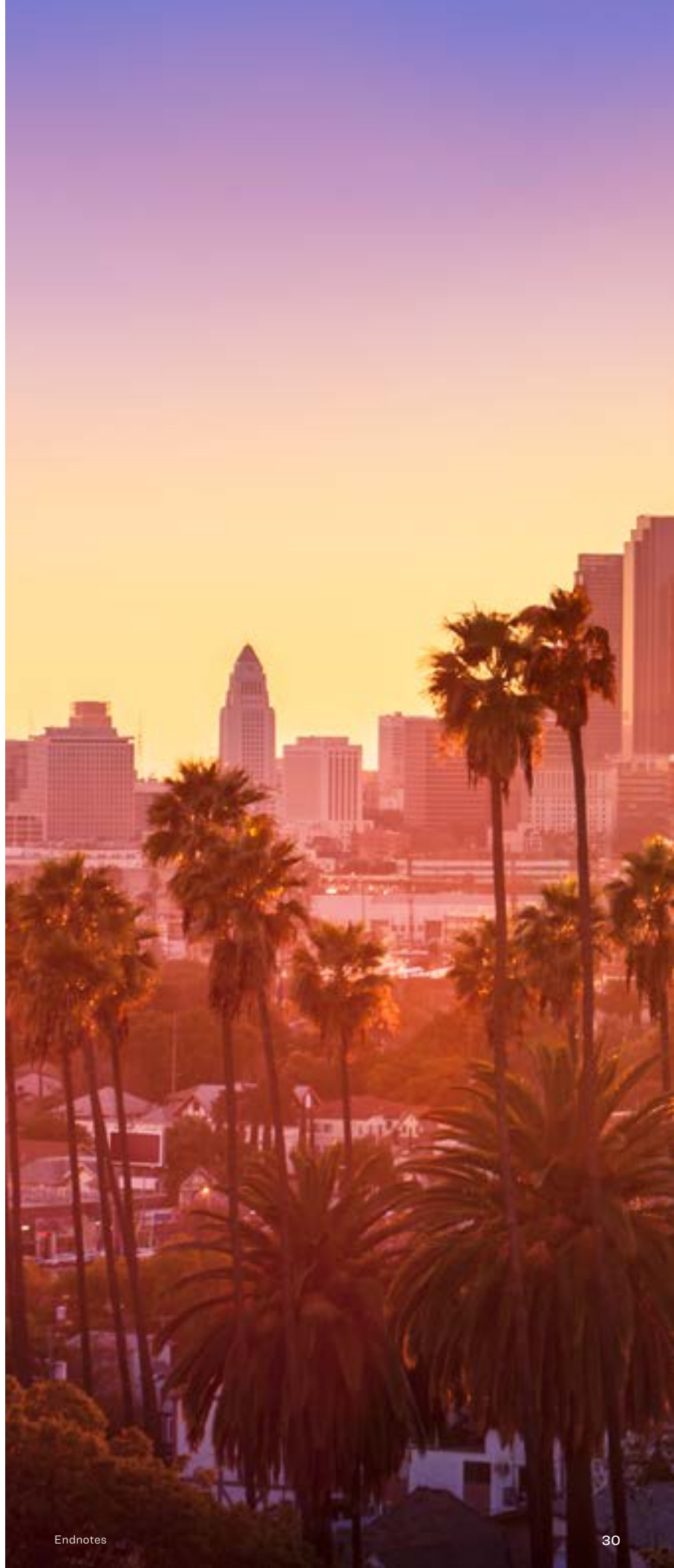
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