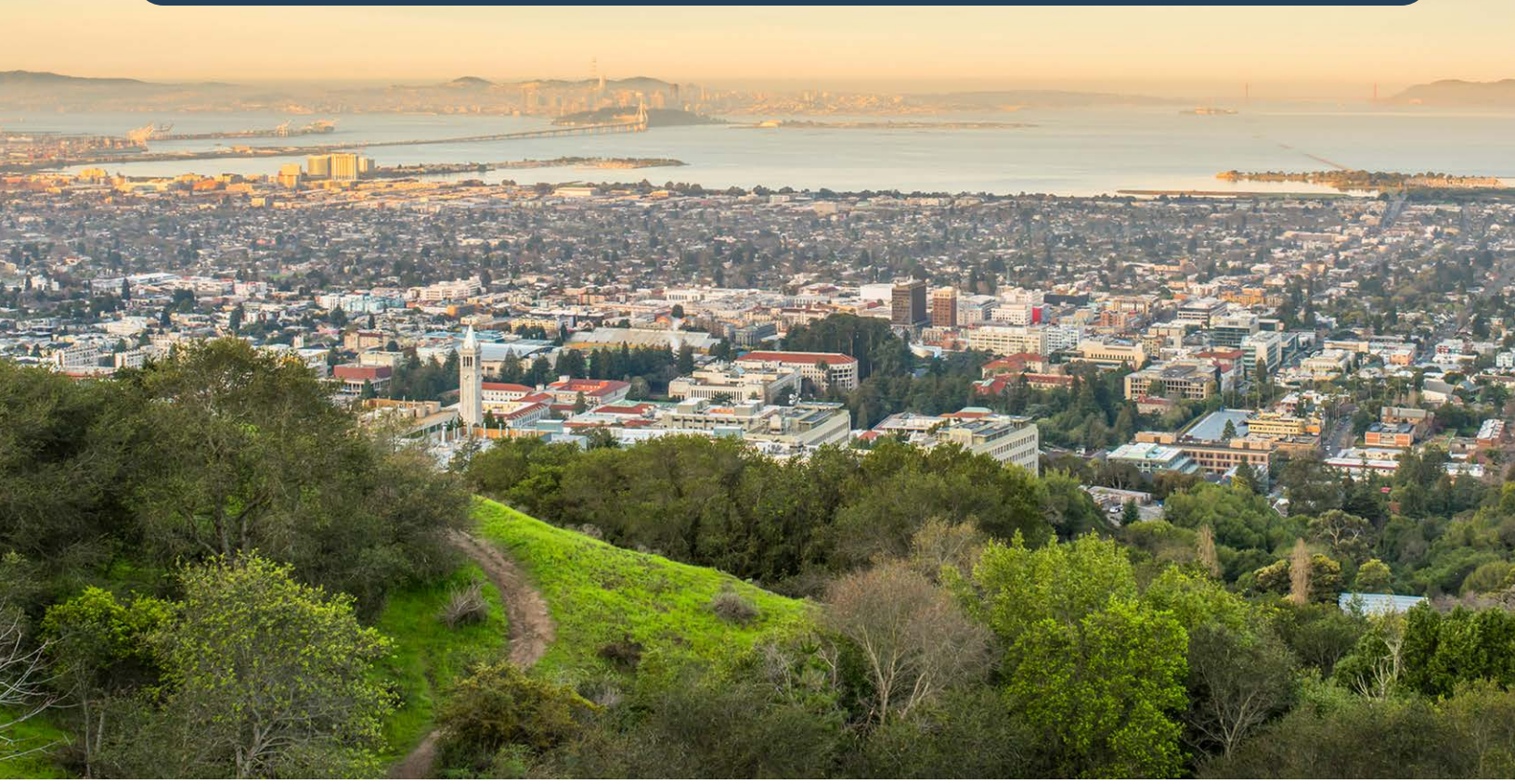
City of Berkeley, California

Existing Buildings Electrification Strategy



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EXECUTIVE SUMMARY

E-1 INTRODUCTION

Berkeley's Existing Buildings Electrification Strategy (Strategy)[1] lays out research and recommendations on how to address the climate crisis through beneficial electrification. The report focuses on low-rise residential buildings, the most common building type in Berkeley.[2] The Strategy provides a framework for how to transition to all-electric buildings in a way that includes and benefits all residents, especially members of historically marginalized communities. The Strategy's phased approach includes specific actions, policies, funding mechanisms, and a tentative timeline to transition Berkeley's existing building stock off natural gas (gas) as soon as possible and no later than 2045. See Figure E-1.

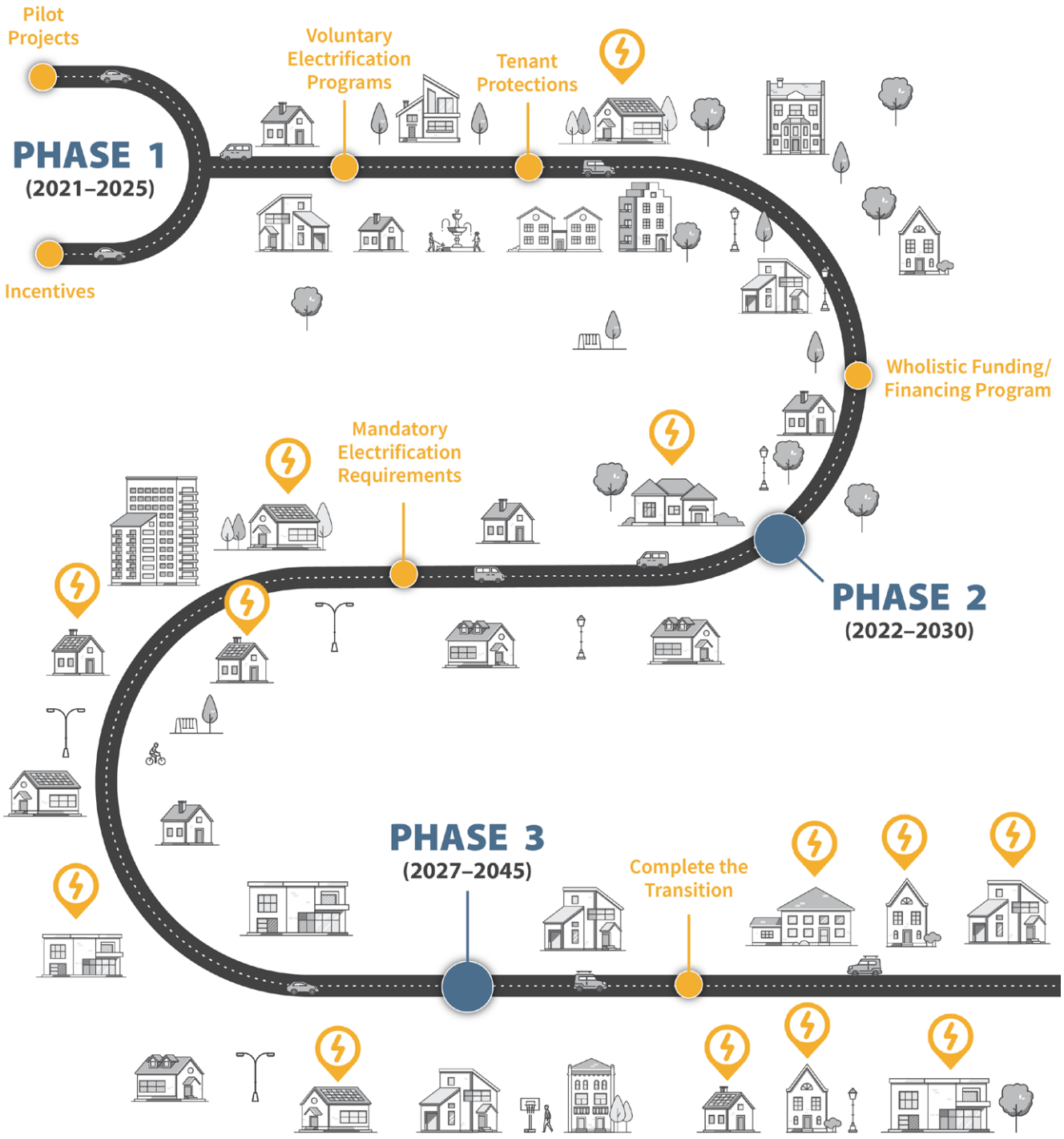
Beneficial Electrification

Beneficial electrification means replacing fossil fuel use with electricity in a way that results in reduced greenhouse gas emissions, more grid resiliency, and lower energy costs for residents. In Berkeley's Strategy, electrification refers to beneficial electrification.

1 *Berkeley's Existing Building Electrification Strategy can be found at: www.cityofberkeley.info/electrification*

2 *In Berkeley, low-rise residential buildings account for 91% of all buildings and 65% of total square footage*

Figure E-1. Berkeley's Existing Buildings Electrification Timeline



E-2 RESEARCH AND APPROACH

A. EQUITY AND COMMUNITY ENGAGEMENT

Applying an equity approach to the electrification of existing buildings means that all people must have affordable access to the health, comfort, economic and resilience benefits of building electrification – but that low-income and other marginalized communities[3] and communities most impacted by climate change should be prioritized. This requires intentionally lifting voices and needs of those who are usually not represented in policy development, and redesigning policies that don't specifically benefit marginalized communities, even if it upends a preconceived goal.

Recognizing the impacts that race and deep-rooted racist policies have on socioeconomic and health impacts, the community engagement approach focuses on people of color as a priority marginalized group. The City will continue to work with all communities to further establish the targeted approaches required for successful implementation of the Strategy.

Two core priorities of this Strategy development are 1) centering equity, and 2) building community trust and relationships. To achieve these goals, staff from the Ecology Center, a trusted partner within the community, conducted targeted outreach efforts on behalf of the City, meeting with local community leaders and organizations that represent marginalized communities to gather information on how to engage the larger community and get initial feedback on building electrification. While the project team prioritized equity-centered targeted engagement, traditional outreach including public meetings and an on-line survey was also conducted.

Definition of Equity

For the purpose of this Strategy, consistent with the Greenlining Institute, equity is defined as:

"Increasing access to power, redistributing and providing additional resources, and eliminating barriers to opportunity, in order to empower low income communities to thrive and reach full potential" and includes "transforming the behaviors, institutions, and systems that disproportionately harm people of color."[4]

3 *Marginalized communities in Berkeley include Black, Indigenous, Communities of Color (BIPOC), low-income communities, people living with disabilities, non-English speaking communities, immigrants, refugees, seniors, young children, the LGBTQ+ community, and other people groups who have been historically marginalized, under resourced and/or have experienced procedural, distributional, and structural inequalities.*

4 *https://greenlining.org/publications/reports/2019/making-equity-real-in-mobility-pilots-toolkit/*

B. BUILDING STOCK ANALYSIS OVERLAID WITH SOCIO-ECONOMIC INDICATORS

The Strategy includes an in-depth analysis of Berkeley's building stock, conducted with support from the Building Electrification Institute (BEI). The building stock analysis reveals that many Berkeley buildings have several challenging conditions for electrification, including poor envelope insulation/sealing, leaky HVAC ducts, knob-and-tube wiring, lower capacity electric panels, and asbestos. Given these challenges, there will not be a one-size solution for all buildings, and a variety of policies and tactics are needed. BEI also helped develop a series of socioeconomic maps of Berkeley, overlaying the building stock with demographic data including race, income, emergency visits due to asthma, gentrification and displacement. These maps help inform potential implications of electrification policies and potential areas to target programs.

C. RETROFIT COST ANALYSIS

The cost analysis uses a building-by-building energy model to quantitatively estimate the local costs of electrification based on current market conditions. It identifies the opportunities for cost-effective electrification, and proposes policy ideas to make building electrification cost-competitive for all Berkeley residents. This analysis identifies the most cost-effective retrofit packages and investigates potential funding mechanisms for full electrification. The cost analysis shows electrification is currently expensive, with cost-effectiveness impacted by factors such as Berkeley's mild climate, high labor costs, current electricity rates, and an older building stock requiring upgrades. Based on modeling, larger single-family homes with higher energy uses are likely to see greater financial benefits.

Despite the relative high costs for electrification under current market conditions, the cost analysis identifies some opportunity areas, including:

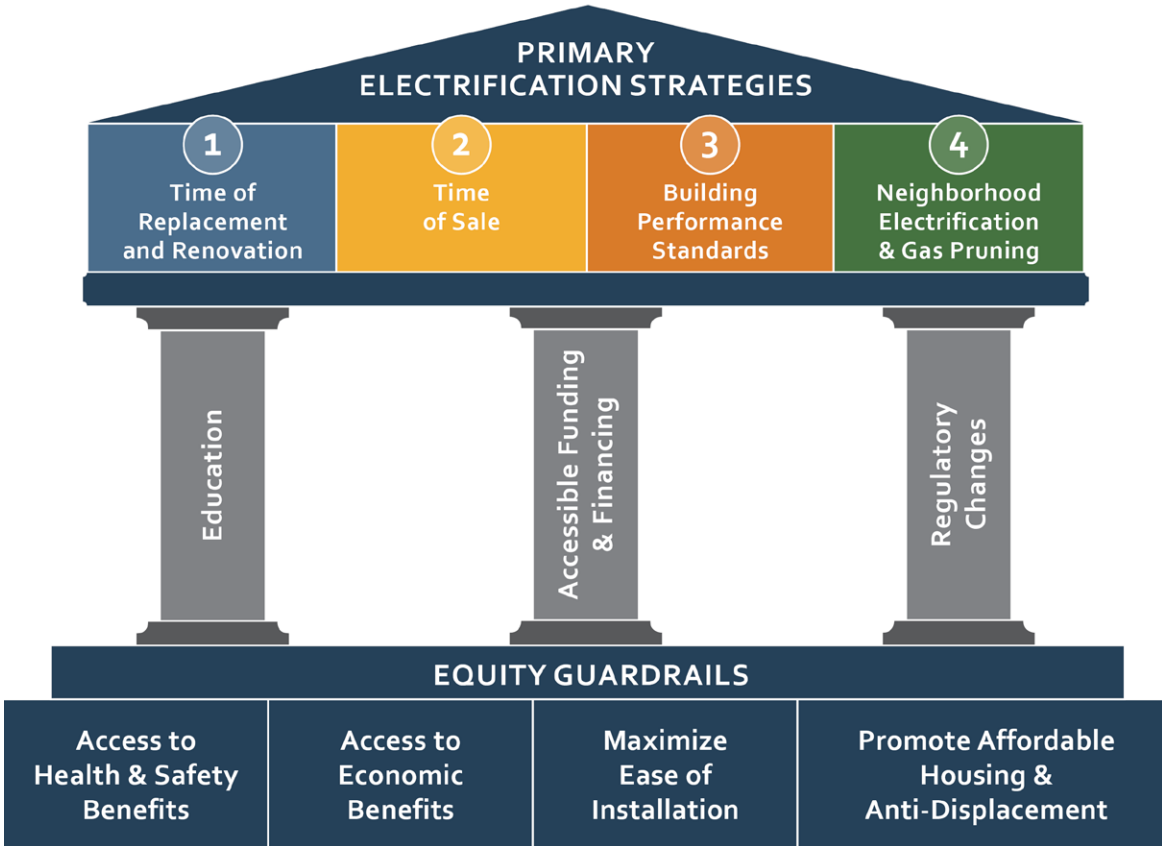
- When installing solar, batteries, or electric vehicle chargers
- When replacing or installing air conditioning
- When purchasing or refinancing homes
- At point of replacement for existing equipment

It is crucial to put the modeled costs in the context of the substantial costs from inaction or delayed action. Appliance electrification is the lowest-cost and least-risky pathway to decarbonize the building sector, especially when considering the avoided societal impacts of pollution and climate effects.

E-3 FRAMEWORK FOR EQUITABLE ELECTRIFICATION

Completely electrifying Berkeley's building stock as quickly as possible, and no later than 2045, will require a combination of new and modified policies by local, state, and federal governments. The Strategy includes four policy areas, with an understanding that no single policy will be sufficient to electrify Berkeley's existing buildings. The policies are: Time of Replacement and Renovation, Time of Sale, Building Performance Standards, and Neighborhood Electrification & Gas Pruning. These policies require successful support from the three essential pillars of education, accessible funding and financing, and regulatory changes that must be enacted for implementation. The foundation of this work must be grounded in equity, operationalized through equity guardrails (described in the next section). Figure E-2 shows a visual representation of this framework structure.

Figure E-2. Existing Buildings Electrification Structural Approach



A. EQUITY GUARDRAILS

In response to the issues raised by communities and advocates, the team developed the concept of equity guardrails, which serve as the foundation of the Strategy and act as minimum standards that must be met for any proposed electrification policy to be considered. The equity guardrails distill the diverse concerns about impacts and equity into a tool that can be used to inform policies and maximize community benefits.

Access to Health and Safety Benefits

Ensure marginalized communities and others most impacted by climate change equitable access to health, safety and comfort benefits from electrification like cleaner air and cooling for hot days (Chapter 1) for both homeowners and renters. Due to the upfront costs of electrification and lack of incentives for owners of multifamily buildings (see Chapter 2), many households will need financial support to have access to high quality upgrades and the benefits of electrification, including long-term cost savings.

Access to Economic Benefits

Ensure all community members, especially marginalized communities have equitable access to affordable funding and financing mechanisms, and to high-road job opportunities.

Maximize Ease of Installation

Ensure that incentives and programs for the community provide meaningful support to renters, owners, and marginalized community members to provide a simple process that minimizes the burdens and impacts associated with the installation of high quality electric equipment installed by a fairly paid and well trained workforce. [5]

Promote Housing Affordability & Anti-Displacement

Ensure upgrades don't displace renters or over-burden homeowners. Programs should support housing production, housing preservation, and tenant protections.

5 *For example, many rebate programs require residents to pay up-front costs and get repaid later, but this model does not work for many including low-income communities.*

The development and implementation of the equity guardrails led to substantial changes to the Strategy, including the creation of the phased approach, which attempts to meet the urgency of the climate crisis while addressing equity and assuring that solutions include all residents and buildings. After hearing community feedback with concerns about increased utility bills and equipment costs, and the need for additional education, trust-building, funding and financing options, the Strategy's implementation timeline was adjusted to be phased and flexible to ensure that the electrification transition could be accessible and equitable. Additional themes outlined by the community, such as the need to link electrification to other health and safety home upgrades were integrated into the recommended actions.

B. PRIMARY ELECTRIFICATION STRATEGIES

The Strategy includes detailed actions which fall under four primary policies, with the equity guardrails influencing the timing of their implementation. The actions are broken into three phases based on available data, technology, and anticipated equity impacts. Phase 1 focuses on expanding and verifying the identified cost effectiveness and equity impacts implementing foundational programs, and building community capacity. Phase 2 increases the stringency of the policies and begins to introduce mandatory measures, once sufficient supports are in place. Finally, Phase 3 policies finalize the move toward all-electric buildings through mandatory measures. Berkeley will need to act quickly to move through the phases and work collectively to support systemic changes (see Section C), in order to achieve complete building electrification by 2045, or sooner if possible. Below is a summary of each policy area and a summary of actions.

1. Time of Replacement and Renovation (TR)

Replace gas equipment at the end of its useful life, either when the gas equipment fails or when a major building renovation is taking place. This is the most cost-effective time to install electric heating/cooling systems and appliances, because the marginal cost (difference between installing electric equipment and replacing with new gas equipment) at this time is smaller than the full cost of installing electric equipment.

Summary of Phased TR Actions

- **TR Phase 1 –** Demonstrate leadership on electrifying municipal buildings, educate and engage residents, collaborate to develop low-income pilot programs for electric replacements, incentives and financing, streamline building and zoning permitting for installing electric heat pumps, and protect tenants.
- **TR Phase 2 –** Develop time of replacement and renovation requirement policies.
- **TR Phase 3 –** Prohibit gas equipment.

2. Time of Sale (TS)

Implement requirements that are triggered when a building changes ownership. This policy generally applies to single-family homes since they are sold more frequently than other types of buildings. Time of sale requirements are currently required through Berkeley's Building Emissions Saving Ordinance (BESO) and could be expanded to include a range of required measures such as an electrification-ready panel upgrade, appliance replacement, or whole building electrification and incentives.

Summary of Phased TS Actions

- **TS Phase 1 –** Identify incentives and funding and financing programs, and develop time of sale energy upgrade options.
- **TS Phase 2 –** Adopt and implement time of sale energy upgrade requirements and implement permit compliance review program to improve compliance with time of replacement policies.

3. Building Performance Standards (BP)

Establish building-level requirements such as minimum GHG emissions standards or elimination of gas systems or equipment by a specified date. These standards are generally applied to larger buildings, including multi-family residential and commercial buildings, in order to have the highest impact on the largest energy users. The size and type of building covered could expand over time.

Summary of Phased BP Actions

- **BP Phase 1 –** Develop requirements for building performance standards that lead to the elimination of gas in Berkeley's large buildings.
- **BP Phase 2 –** Increase and expand requirements to include more buildings; identify tools, funding and financing to assist building owners to reduce emissions and assure tenant protections.
- **BP Phase 3 –** Consider emissions fees to pay for electrification for low-income buildings, with tenant protections.

4. Neighborhood Electrification & Gas Pruning (NE)

Create a plan to strategically reduce and eventually eliminate gas infrastructure in the city. Neighborhood-level electrification can be a more equitable way to electrify communities as opposed to a building-by-building approach which will leave those who cannot afford to electrify with higher gas rates. Larger scale projects also create more opportunities for high road jobs and could incorporate resilience measures such as on-site solar and islandable backup battery storage that could act as a neighborhood micro-grid to improve energy assurance.

Summary of Phased NE Actions

- **NE Phase 1 –** Develop and implement a neighborhood decommissioning pilot program that demonstrates overcoming regulatory and financial barriers, accesses multiple funding sources, provides economic benefits and high road jobs, and protects tenants from displacement.
- **NE Phase 2 –** Develop gas pruning plan and begin pruning in lieu of repair and replacement.

5. Cross Cutting (CC) Actions

In addition to the four primary policies for advancing existing building electrification, there are also cross-cutting actions that support the overall success of electrification both in the City and beyond. Many of these actions cannot be taken by the City alone and will need wider collaboration from regional partners and the State.

Summary of Phased CC Actions

- **CC Phase 1 –** Partner with community organizations to build trust and provide education on building electrification; collaborate with state and regional partners to advocate for fair utility rates and accessible funding and financing options; advocate for technology improvements that lead to emissions reductions; develop and measure equity outcomes; expand analysis to commercial and industrial buildings; and, develop high road jobs policies and labor standards to support family-sustaining union construction careers for underrepresented communities.
- **CC Phase 2 –** Develop programs, such as bans or fees on new gas equipment, dedicated investments, funding and financing for marginalized communities, and bulk purchase programs to reduce costs; collaborate with the City's Rental Housing Safety Program; and, adopt a no gas reconnection policy for buildings that have gone all-electric.
- **CC Phase 3 –** Develop time of lease requirement; collaborate with regional and state stakeholders to modernize utility's Obligation to Serve requirement to exclude gas; and, secure funding and financing needed for low income property owners and renters tied to tenant protections to address split incentive barriers in multi-family buildings.

C. SUPPORTING PILLARS

Electrification of existing buildings will require long-term and systematic changes. To ensure successful implementation of the policies, three pillars (education, accessible funding and financing, and regulatory changes) are essential to creating policies that will engage, invest in, and support the entire community through the transition away from fossil fuels.

- **Education –** While electrification is not new, there are new and improved technologies, and many benefits to electrification that are not widely known. Providing ongoing education on new technologies, requirements, incentives, policies, and programs, a need expressed by many community members, is a key step to achieving widespread adoption. Robust and targeted education and outreach need to be provided to a wide range of stakeholders with a focus on marginalized communities.
- **Accessible Funding & Financing –** Ensuring that sufficient funding and financing options are accessible to renters, homeowners, and property owners – with a focus on marginalized communities within each of these groups – will allow the four primary policies to be implemented in an equitable manner.
- **Regulatory Changes –** Phasing out gas from buildings will require significant changes to the regulations and systems that currently support our buildings and infrastructure. These could include policy changes that allow reprioritization of resources, changes to permit requirements, or regulations on appliances and fuel use, while assuring tenant protections. While the City cannot drive this change alone, it can work to coordinate with other jurisdictions and agencies to advocate for these changes.

E-4 A CALL TO ACTION

This call to action outlines some of the key areas that the Berkeley community and partner cities can implement today both as individuals and collectively to advance building electrification.

What Can Berkeley Residents Do Now?

Many existing buildings within the City of Berkeley can be electrified today in a cost-effective manner. While some community members will need funding and access to financing or other support to make electrification feasible there are key situations when electrification should be considered today, such as when purchasing a new home, at time of renovation or replacement of equipment, and when replacing an old air conditioning unit, furnace and/or water heater or installing a new air conditioning, solar panels, batteries and/or an electric vehicle charger.

What Can Other Cities Do?

The Strategy offers lessons learned and resources that could be leveraged by other jurisdictions to advance electrification of existing buildings, and to encourage collective actions among cities to achieve the large-scale equitable electrification needed to meet our climate goals and address the climate crisis.

While this Strategy focuses specifically on Berkeley's building stock, climate, and communities, aspects of this Strategy can be applied to other cities. Other cities interested in developing strategies to electrify their existing buildings can start with:

- Community engagement with a focus on marginalized communities.
- Building inventories with socioeconomic mapping overlay.
- Pilot projects and strategic investments with equity focus.

In addition, collective action across the State of California and beyond is needed to accelerate the transition off gas and shift the regulatory and market conditions for large scale equitable electrification. Some topics to address together include:

- Advocate for accessible funding & financing programs.
- Advocate for gas rates that reflect societal costs along with affordable and equitable electric rates including rates for rooftop solar (NEM 3.0).
- Advocate for utility accounting and planning reform that accounts for the true cost of fossil fuels and the climate, health, safety and resilience benefits of electrification.

1. INTRODUCTION

The City of Berkeley (the City) is actively working to mitigate its greenhouse gas (GHG) emissions and transition towards a fossil fuel-free future in which all community members benefit from clean and affordable energy; healthy, safe and comfortable homes; and inclusive high quality employment opportunities.

The City of Berkeley has a strong history of sustainability leadership. In 2006, the Berkeley community (Berkeley) overwhelmingly voted for a ballot measure to reduce the community's GHG emissions by 80 percent below 2000 levels by 2050, and the City's first Climate Action Plan[6] was adopted in 2009. The City and the State of California have set various goals to accelerate the transition to a fossil fuel-free, or decarbonized future. In 2018, Berkeley City Council signaled the urgency and importance of climate action by declaring a Climate Emergency and the goal of becoming a Fossil Fuel-Free City as soon as possible. Also in 2018, Governor Brown signed Executive Order B-55-18, committing California to carbon neutrality by 2045.

To reach these goals, the City has implemented programs such as the Building Emissions Saving Ordinance (BESO),[7] which requires Berkeley building owners to complete energy efficiency opportunity assessments and report the building's energy efficiency information at time of sale. In 2016, the City joined East Bay Community Energy (EBCE), Alameda County's community-based electricity provider committed to providing increased access to affordable and renewable electricity for all customers, resulting in lower emissions from electricity in Berkeley. Most recently, Berkeley became the first city in the Country to prohibit natural gas (gas) in new construction, setting off a wave of similar ordinances across the State. At the time of writing this report, over 49 cities in California have adopted ordinances to ban or limit new gas infrastructure in new construction.[8] By eliminating fossil fuel use in new construction, Berkeley effectively eliminated gas in new buildings and stopped the expansion of gas infrastructure within its jurisdiction. The next challenge is electrifying existing buildings which are more complex and costly to retrofit than new buildings.

6 *https://www.cityofberkeley.info/climate/*
7 *https://www.cityofberkeley.info/BESO/*
8 *As of August 2021: https://www.sierraclub.org/articles/2021/06/californias-cities-lead-way-gas-free-future*

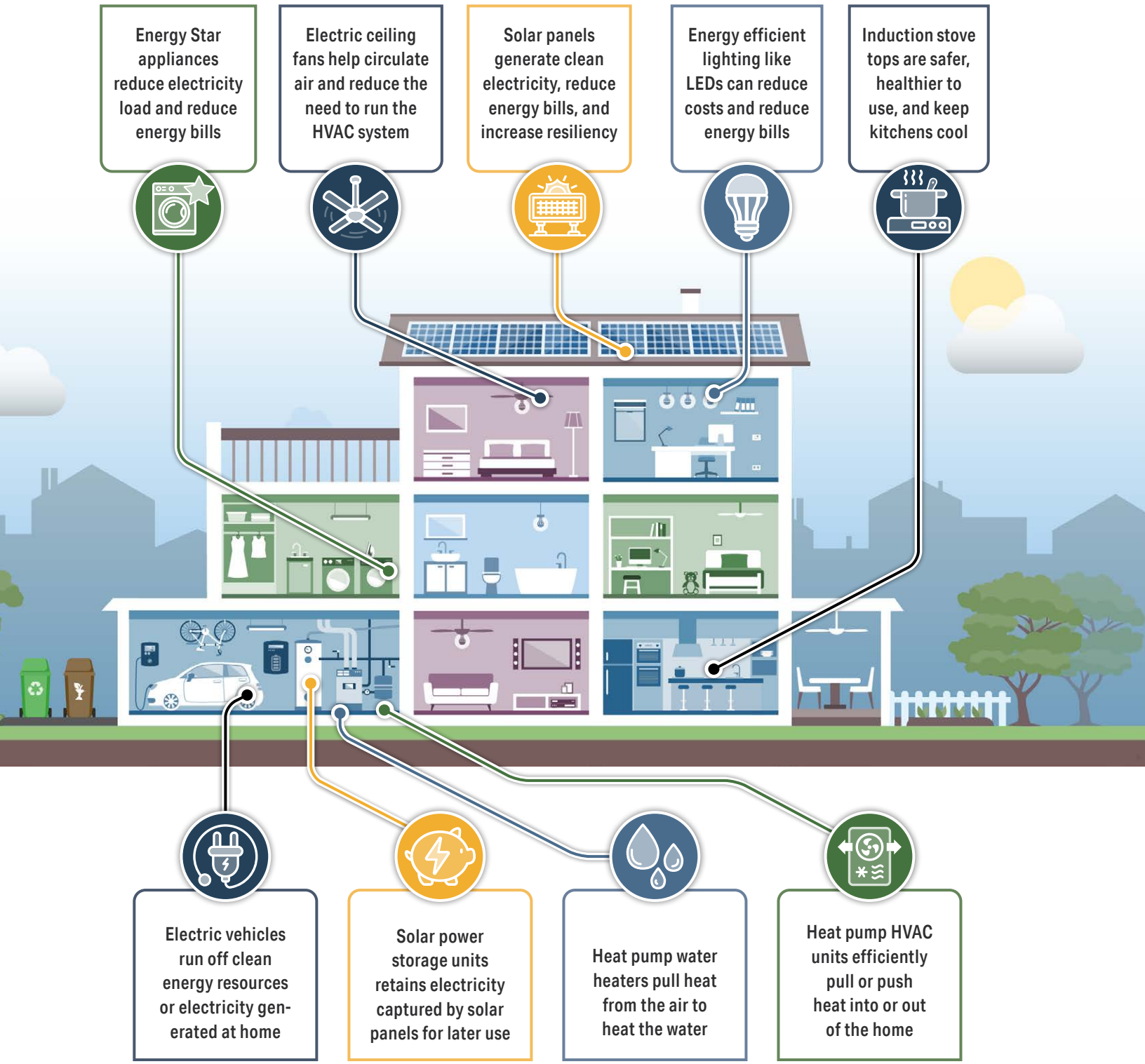
BENEFICIAL ELECTRIFICATION

As the electricity supply becomes cleaner and EBCE provides access to more renewables, the City has identified existing building electrification as a priority to further decarbonize the community. Electrification is the process of switching the fuel source of our transportation vehicles and building appliances and other equipment from fossil fuels, such as gasoline, diesel, gas, and propane, to electricity. Beneficial electrification takes this idea further and ensures that electrification results in reduced GHG emissions, more grid resiliency, and lower energy costs for residents. With the availability of renewable electricity associated with Senate Bill (SB) 100 and EBCE, this switch to electrification, if done equitably, opens up the potential for significant benefits including reductions in GHG emissions, improved health and safety, cost savings, and more. In Berkeley's Existing Buildings Electrification Strategy (Strategy), electrification refers to beneficial electrification.

Beneficial Electrification

Beneficial Electrification is defined as a switch from fossil fuels to electricity in a way that reduces GHG emissions, and improves cost effectiveness, health and safety, and resilience.

Figure 1-3. Existing Building Electrification



1.1 REASONS FOR ELECTRIFICATION

This section discusses several benefits to electrification including:

- Greenhouse gas reduction
- Health: Indoor air quality, outdoor air pollution
- A changing climate: Comfort, resilience
- Safety: Earthquakes, aging infrastructure, accidental explosions/fires
- Cost Savings
- High quality job growth
- Equity

GREENHOUSE GAS REDUCTION

Berkeley and the State of California are committed to achieving carbon neutrality as soon as possible, and no later than by 2045. Achieving this goal will require significantly limiting GHG emissions from buildings, which currently represents approximately 37 percent of Berkeley's total annual GHG emissions.[9] These emissions stem from two primary sources, electricity (6 percent), and gas (31 percent). The benefit of electricity is that it can currently be generated by 100 percent renewable sources like wind and solar. In addition, the City of Berkeley joined its local Community Choice Aggregator, EBCE, which offers the community the option of a 100 percent renewable electricity service. This means that an all-electric building can operate carbon-free, today.

On the other hand, gas has a high carbon content or emission factor,[10] and while increased appliance efficiency can marginally reduce the GHG emissions associated with using gas in our homes, it cannot reach zero. Furthermore, the elimination of gas in buildings will ultimately allow for the strategic decommissioning of gas distribution infrastructure and the associated leakage of methane, the main component of gas. This is significant because methane traps 28-36 times more heat that carbon dioxide over a 100 year period.[11]

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9 *According to 2018, as reported in 2020: https://www.cityofberkeley.info/Clerk/City_Council/2020/07_Jul/Documents/2020-07-21_Special_Item_05_Climate_Action_Plan_pdf.aspx*

10 *An emission factor is a number that converts a unit of energy into the amount of emissions that it generates. The standard emission factor for gas is 0.00532 Metric Tons of CO_2e per therm of gas combusted (https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf) . Electricity emission factors can vary significantly depending on the source of electricity with renewables and other carbon-free sources having an emission factor of 0.0 Metric Tons of CO_2e per kWh.*

11 *https://www.epa.gov/ghgemissions/understanding-global-warming-potentials*

Lower emissions alternatives to extracted gas do exist, including biogas and hydrogen.[12] However, current studies indicate that these technologies will be costly and their limited availability will make it difficult to fully off-set the current gas demand. Instead, these alternative carbon-free fuels and the existing gas infrastructure system needed to transport them will likely be used for buildings that are harder to electrify like industrial facilities, or for electricity generation during times of low renewable power availability.[13]

The combination of California's GHG emissions reduction goals, current availability of carbon-free electricity, and limited supply of carbon-free alternative gas options, has elevated building electrification as a key strategy in addressing climate change. However, while reducing GHG emissions is one of the primary drivers of electrification it is only one of the many benefits of eliminating fossil fuels from buildings.

HEALTH

Negative health impacts related to ambient air pollutants generated by burning of fossil fuels in power plants, vehicles and industrial operations are widely acknowledged.[14] In many cities, Berkeley included, these issues are also linked to equity issues, as the most cases of hospitalization due to asthma occur in West Berkeley which also has poorer air quality,[15] and a higher percentage of communities of color and low income communities.

By contrast, sources of air pollution inside of buildings and related health effects are often overlooked. A number of commonly used appliances that burn gas, including stoves, heating systems and water heaters, emit substantial amounts of air pollutants, and if not properly ventilated can present significant indoor air quality impacts. Gas-powered appliances are known to emit nitrogen dioxide (NO_2), nitric oxide (NO_x), sulfur oxides (SO_x), particulate matter (PM), carbon monoxide (CO), and formaldehyde (CH_2O). Levels of indoor air pollutants generated by gas cooking generally depend on the age and configuration of burners and ventilation conditions specific to individual homes. The potential health impacts related to cooking with gas appliances can be serious but are generally not widely understood by consumers.[16]

12 *Biogas refers to methane processed out of biogenic sources like organic waste. The use of biogas while limited in scale, could provide a carbon neutral or even carbon reducing fuel source when coupled with carbon capture and storage. However, this technology is not feasible on a building by building scale and will likely be limited to industrial processes. Hydrogen as well can be made using electricity or biogenic sources.*

13 *https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5ced6fc515fcc0b190b60cd2/1559064542876/EFI_CA_Decarbonization_Full.pdf*

14 *https://www.who.int/airpollution/ambient/health-impacts/en/*

15 *https://news.berkeley.edu/2019/05/22/historically-redlined-communities-face-higher-asthma-rates/* and *https://www.cityofberkeley.info/Health_Human_Services/Public_Health/Public_Health_Reports.aspx*

16 *https://ehp.niehs.nih.gov/doi/10.1289/ehp.122-a27*

Indoor Air Quality

The use of gas cooking appliances can be detrimental to indoor air quality, particularly NO_2 pollution. Residences with gas stoves have between 50 percent to over 400 percent higher average NO_2 concentrations than homes with electric stoves.[17] Numerous peer reviewed studies have documented that peak levels of indoor pollution generated by gas stoves can climb well above outdoor air pollutant thresholds. Recent research from Lawrence Berkeley National Laboratory and Stanford University demonstrates that when gas is burned without proper ventilation via range hoods, gas cooking can generate levels of CO and NO_2 inside homes that are in excess of federal and state standards for ambient outdoor air quality.[18] Smaller residences and those that lack range hoods are especially at risk of experiencing poor indoor air quality during cooking. The same study estimates that during a typical week during the winter, 1.7 million Californians could be exposed to CO levels that exceed ambient standards and 12 million could be exposed to NO_2 levels that exceed ambient standards due to combustion of gas inside of homes. Although properly installed and maintained exhaust hoods can reduce levels of NO_2, CO and other pollutants, many buildings are not equipped with well-functioning hoods that vent to the outdoors. Studies suggest many exhaust hoods, including those that only recirculate air, do not uniformly remove air pollutants, particularly when cooking is done using a stove's front burners.[19]

Air Pollution at Home

Burning gas at home without proper ventilation can cause indoor air quality to exceed outdoor air quality standards. Emissions from gas have been linked to asthma and other health issues.

The indoor air pollution that results from the use of gas appliances translates into important health consequences. The United States Environmental Protection Agency (US EPA) recently concluded that long-term exposure to NO_2 is linked to the onset of asthma in children.[20] Furthermore, the US EPA has reported that short-term exposure to NO_2 can also lead to respiratory complications and trigger asthma attacks. A 2013 meta-analysis of prior research assessed the impact of indoor NO_2 pollution on asthma in children living in suburban and urban homes. Results demonstrated that children in homes with gas stoves have a 42 percent higher chance of developing asthma symptoms.[21]

17 https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=194645

18 https://ehp.niehs.nih.gov/doi/10.1289/ehp.122-a27

19 https://rmi.org/insight/gas-stoves-pollution-health/

20 https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879

21 1Weiwei Lin, Bert Brunekreef, Ulrike Gehring. International Journal of Epidemiology, Volume 42, Issue 6, December 2013, Pages 1724–1737, https://doi.org/10.1093/ije/dyt150

The prevalence of asthma in children locally underscores the importance of improving indoor air quality. Over 2,900 children in Alameda County were hospitalized with asthma related complications in 2012,[22] resulting in substantial healthcare costs at the individual and societal levels. Furthermore, the cost of each hospitalization for asthma in California is $33,000, 65 percent of which is paid with public funds.[23] According to the 2018 Berkeley Health Status Report, asthma is one of the most prevalent chronic health conditions among children and adolescents in Berkeley. Controlling asthma improves quality of life, reduces medical costs, and increases productivity at school. Health issues are also an equity concern. The asthma hospitalization rates for children under 5 for African American children is 10 times higher, and for Latino children is 2.8 times higher than the rate among White children.[24]

Along with impacts to respiratory health, a growing body of evidence also suggests that indoor air pollution stemming from gas combustion can impact cognitive development of children. A 2009 study found that exposure to indoor air pollution may be related to impaired cognitive function and attention-deficit/hyperactivity disorder (ADHD) in infant through preschool aged children.[25]

Without proper ventilation, emissions from gas appliances, such as carbon monoxide, can even be deadly. Every year, at least 430 people die in the U.S. from accidental CO poisoning and approximately 50,000 people in the U.S. visit the emergency department due to accidental CO poisoning.[26]

The importance of transitioning from gas powered to electric appliances is underscored by the fact that on average, Californians spend 70 percent of a given day indoors,[27] a condition that has only been exacerbated by the COVID-19 pandemic. As such, the quality of indoor air is a critical factor in determining one's overall health and wellbeing.

22 *https://www.cityofberkeley.info/Health_Human_Services/Public_Health/Public_Health_Reports.aspx and http://www.acgov.org/board/bos_calendar/documents/DocsAgendaReg_10_12_15/HEALTH%20CARE%20SERVICES/Regular%20Calendar/Pay_for_Success_Asthma_Initiative_Health_10_12_15.pdf*

23 *https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHIB/CPE/CDPH%20Document%20Library/Asthma_Surveillance_in_CA_Report_2017.pdf*

24 *https://www.cityofberkeley.info/Health_Human_Services/Public_Health/Public_Health_Reports.aspx*

25 *https://academic.oup.com/aje/article/169/11/1327/159993*

26 *https://www.cdc.gov/dotw/carbonmonoxide/index.html*

27 *https://www.nature.com/articles/7500165*

Outdoor Air Pollution

Beyond the impacts to indoor quality, use of gas-powered appliances also represents a significant contribution to ambient outdoor air pollution. Ambient air quality is a persistent concern in the Bay Area, with particulate matter in the Bay Area regularly exceeding both state and federal standards.[28] Modeling from the California Energy Commission demonstrates that electrification of gas appliances and conventional fireplaces in residential and commercial structures could lead to the largest reduction of particulate matter of less than 2.5 microns in size (PM 2.5) when compared to other sectors, such as transportation and industrial operations.[29] Furthermore, a Massachusetts Institute of Technology (MIT) study found that emissions generated by buildings caused more pollution-related premature deaths in California than any other sector, including transportation and electricity generation.[30] As the recent California wildfires have led to increased wildfire smoke, creating unhealthy and sometimes hazardous air quality for extended periods in the Bay Area, the value of clean air, and discouraging air pollution, has been made even more apparent. By pursuing building electrification, the City of Berkeley will help improve air quality indoors and out, reducing health impacts at the local and regional scale.

28 *https://www.baaqmd.gov/~/media/files/planning-and-research/plans/2017-clean-air-plan/attachment-a_-proposed-final-cap-vol-1-pdf.pdf?la=en*

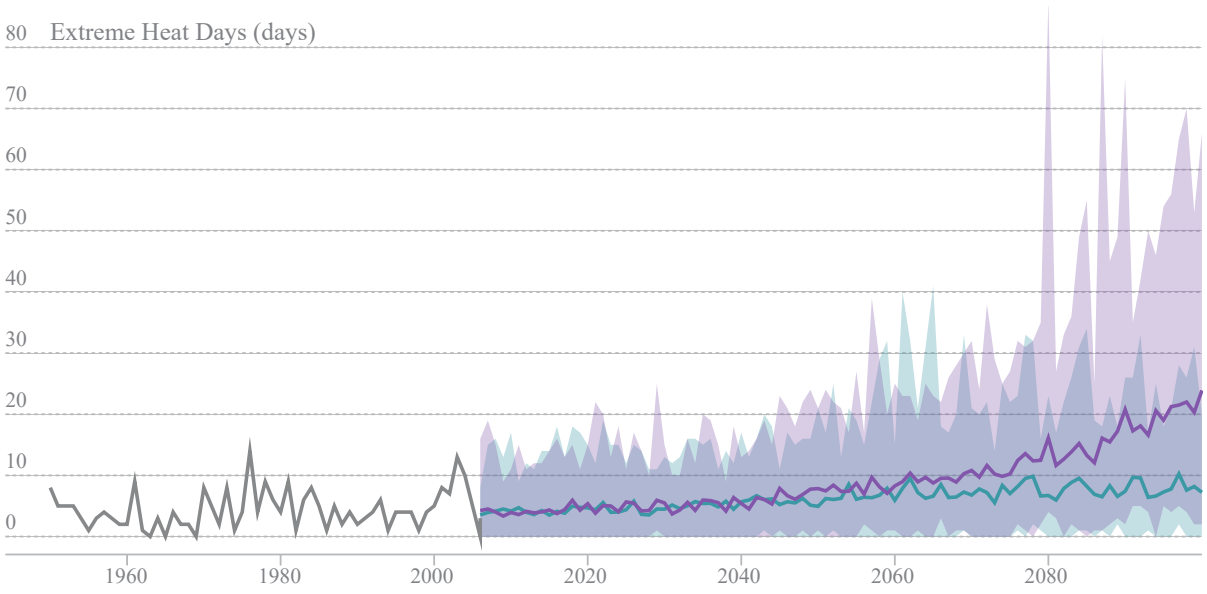
29 *https://ww2.energy.ca.gov/2019publications/CEC-500-2019-049/CEC-500-2019-049.pdf*

30 *https://www.nature.com/articles/s41586-020-1983-8?proof=trueMay*

A CHANGING CLIMATE

According to Cal-Adapt, the number of extreme heat days in Berkeley is expected to double by 2070 as shown in Figure 1-4.[31] Furthermore, the number of warm nights (when the minimum daily temperature never dips below 61.7 degrees F) is expected to increase from just 4 days per year to approximately 40.

Figure 1-4. Extreme Heat Days



Observed (1961-1990) 30yr Average: 4 days

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	3 days	1 - 5 days
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+3 days	6 days	3 - 10 days
HIGH EMISSIONS (RCP 8.5)	+4 days	7 days	3 - 11 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+5 days	8 days	5 - 13 days
HIGH EMISSIONS (RCP 8.5)	+12 days	15 days	8 - 33 days

31 *https://cal-adapt.org/tools/extreme-heat/*

In addition, the Bay Area has already experienced significant impacts from regional wildfires, creating unhealthy air quality and threatening vulnerable populations. California's Climate Change Assessment projected an increase in area burned of 77 percent by the end of the century if emissions continue to rise. The electrification of existing buildings is an important opportunity to prepare for these climactic changes.

Comfort

As the climate warms, air conditioning systems may become substantially more popular in the Bay Area. A 2003 study across 39 U.S. cities found a strong correlation between cooling degree days [32] and air conditioner (AC) ownership.[33] Climate models suggest that cooling degree days in Berkeley will increase 53-72 percent by 2050, resulting in total AC ownership of 31-44 percent. Modernizing old homes and businesses by retrofitting with new electric appliances can improve comfort for building occupants. Electric air space heat pumps perform the dual purpose of both heating and cooling spaces, allowing building occupants that did not previously have air conditioning to remain comfortable and safe during extreme heat events. In addition, new electric heat pumps can be far more efficient than older gas fueled heaters, allowing retrofitted buildings to be heated more cost-effectively. While updating old infrastructure with modern electric ones can have a positive effect on comfort, weatherization alongside electrification will be needed in old, drafty buildings to ensure efficiency. However, combining efficiency and electrification upgrades together can significantly improve occupant comfort while also significantly reducing both heating and cooling costs.

32 *Cooling Degree Day–A cooling degree day (CDD) is a measurement designed to quantify the demand for energy needed to cool buildings. It is the number of degrees that a day's average temperature is above 65° Fahrenheit (18° Celsius).*

33 *Sailor et al, 2003 (https://doi.org/10.1016/S0360-5442(03)00033-1). See Figure 1(a).*

Resilience

As discussed in Berkeley's Resilience Strategy,[34] a city's resilience is defined by the ability of the community to survive, adapt and thrive no matter what acute shock or chronic challenge it experiences. Advancing Berkeley's resilience requires working together to identify solutions that have multiple benefits and address multiple challenges at once. The electrification of existing buildings can result in increased health and comfort, as well as resiliency to the impacts of climate change, including extreme heat and wildfires. All-electric buildings, coupled with solar and battery energy storage, can also mitigate impacts of power outages and utility-led public safety power shutoff (PSPS) events in times of high fire risk.

Efficiency and Resilience

Pairing heat pump HVAC units with good air filtration, and a weatherized and well-sealed home means significant protection from wildfire smoke during fires and cooling on extreme heat days.

Clean backup power is an important asset when the utility grid is down, including earthquakes and PSPS events. Utility-led PSPS events, where the utility proactively turns off electric power during extreme weather events in order to help prevent wildfire, are becoming more regular and remain a concern for Berkeley and much of California – especially for those medically dependent on power. While many people think having gas provides a redundant system during PSPS events, during an electric power shutoff many appliances including gas heaters, stoves and hot water heaters cannot function due to the electric fans and controls they need to operate. During these events, the community members need backup power, and while fossil fuel-powered generators are an option, these are a fire hazard during high fire risk times, cause additional air pollution during periods which often overlap with wildfire smoke / Spare the Air days, and exacerbate climate change and the resulting increase in wildfires. Investing in our electricity grid and clean distributed energy and storage systems like solar and battery storage provide the opportunity to improve resilience overall – and are safer, cleaner, and healthier options. An all-electric building equipped with on-site renewable energy generation and battery storage can allow essential equipment to run without the risk of sparking wildfires when PSPS events are required.

34 *https://www.cityofberkeley.info/Resilience/*

SAFETY

While there are safety concerns associated with both gas infrastructure and the electrical grid, the distribution and use of gas in residential and commercial buildings carries an inherent safety risk due to the volatile nature of gas. As California moves towards electrification, this provides an opportunity to invest in and enhance one safe and reliable electrical system rather than continuing to manage two systems. Recent accidents in the Bay Area, including the 2010 San Bruno and 2019 San Francisco gas pipeline explosions, demonstrate that serious incidents can happen. The safety and reliability of gas infrastructure is threatened by a number of factors, including:

Earthquakes

As an earthquake-prone city, the potential for seismic impacts to gas infrastructure is elevated in Berkeley. The City is located on the Hayward Fault, which is noted as one of the more dangerous earthquake faults in the United States.[35] Depending on the location and intensity of an earthquake, seismic activity could damage gas pipelines, potentially causing destructive fires and disruptions to service. According to the California Seismic Safety Commission, between 20 to 50 percent of post-earthquake fires are typically caused by gas leaking from damaged pipes.[36] Further, in the event of a long-term grid outage as a result of an earthquake, it is expected that electrical service would be restored much quicker than gas service.[37]

Aging Infrastructure

California's gas distribution systems are among the oldest in the United States,[38] adding to overall system vulnerability and failure risk. Older gas pipelines are more likely than electrical lines to sustain damage during earthquakes and are susceptible to leaks, causing inefficiencies and threatening safe operation. Furthermore, aging pipelines may lose structural integrity over time, becoming vulnerable to catastrophic failure, as experienced in the 2010 San Bruno explosion.[39] In addition, recent studies have found that gas infrastructure around the country is leaking substantial amounts of methane, a potent

35 *https://www.sfchronicle.com/bayarea/article/Berkeley-elementary-school-to-move-due-to-14869596.php)*

36 *https://ssc.ca.gov/wp-content/uploads/sites/9/2020/08/cssc_2002-03_natural_gas_safety.pdf*

37 *https://www.onesanfrancisco.org/sites/default/files/inline-files/Lifelines%20Restoration%20Performance%20Report%20Final.pdf*

38 *https://rmi.org/a-new-approach-to-americas-rapidly-aging-gas-infrastructure/*

39 *https://docs.cpuc.ca.gov/publishedDocs/published/Graphics/157326.PDF*

greenhouse gas 86 times stronger than carbon dioxide, into the atmosphere.[40] Based on the leakage estimates for San Francisco, GHG emissions from gas in the City of Berkeley may be up to 25 percent higher than current estimates capture.[41]

Accidental Explosions/Fires

Gas is highly flammable. A common cause of gas pipeline explosions and subsequent fires is accidental damage during excavation or other subterranean work, as was the case during the 2019 explosion in San Francisco.[42] Although education and utility-led outreach campaigns have increased awareness around necessary precautions during subterranean construction and maintenance, gas infrastructure poses an inherent safety risk in the event it is accidentally damaged.

Gas can also cause fires in buildings. According to the National Fire Protection Association, local fire departments responded to an average of 4,200 home structural fires between 2012-2016 which started with the ignition of gas. These fires caused an average of 40 deaths, 140 injuries, and $54 Million in direct property damage per year. Leaks or breaks were factors in 20 percent of the fires and 54 percent of the deaths, and operating equipment (cooking, water heaters, fixed/portable space heaters, central heat) ignited the gas in 58 percent of the fires and 32 percent of the deaths.[43]

By pursuing electrification, the City of Berkeley can reduce its dependence on aging and vulnerable gas infrastructure, lowering the probability of a catastrophic incident as experienced in other neighboring Bay Area communities.

40 https://thegasindex.org/

41 *Emission factor for Gas Combustion – 0.00531 MT CO_2e/Therm. Additional Emission Factor for leakage (https://thegasindex.org/) 0.00131 = ~25% higher.*

42 https://www.sfchronicle.com/bayarea/article/Explosion-in-San-Francisco-causes-fire-injuries-13595313.php

43 https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Hazardous-materials/osNaturalGasPropaneFires.ashx#:~:text=An%20estimated%20average%20of%204%2C200,of%2040%20deaths%20per%20year

COST SAVINGS

Building electrification – if planned thoughtfully, strategically and equitably – has the potential to provide cost savings both through more efficient appliances, and by eliminating the costs associated with installing and maintaining gas infrastructure. These costs can impact people differently and will vary building by building needs for electrification, electricity rates used, appliances installed, and whether rooftop solar is included.

In terms of the costs of gas infrastructure, a significant portion of the cost of gas is the installation and maintenance of gas infrastructure. The California Public Utility Commission generally allows each gas utility to increase gas rates based on the necessary expenditure to keep gas systems operational, a process which has increased after the San Bruno explosion. While the cost of the gas itself varies depending on usage (as you use less gas, your bill goes down) these fixed infrastructure costs remain the same. It should be noted that there are similar issues of electric rates based on the amount of energy used for fixed utility which need to be addressed.

As California strives to meet its goals of reaching carbon neutrality by 2045 and improving the efficiency of its buildings by 50 percent, the amount of gas consumed in California will significantly decrease.[44] Without any building electrification or renewable alternatives,[45] the cost of gas is expected to double from approximately $1.5 per therm to $3 per therm by 2050 due to lower gas throughput from more efficient houses and appliances and reinvestment in new gas infrastructure.[46] These projected increases are already being seen with one California investor owned utility requesting a general rate case increase for 2021 that is 42 percent higher than the increase requested in previous years. In order to meet the State's GHG reduction goals without building electrification, there would be an estimated incremental annual cost ranging between $19-32 billion in California, mostly due to high costs associated with producing renewable gas alternative forms of gas.[47] Comparatively, a high building electrification scenario had an incremental annual cost of approximately $13 billion. Collectively, a proactive transition to electrified buildings in California can be associated with significant long-term cost avoidance by limiting the amount of new gas infrastructure investments.

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44 https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB350

45 *While state policy goals imply reducing or even eliminating the use of fossil gas in California by 2050, the gas delivery system can continue to play a useful role in supporting the decarbonization of end-uses that cannot electrify by supplying them with biomethane, hydrogen produced using renewable electricity (also called "green hydrogen"), and synthetic gas (SG) produced from green hydrogen and captured carbon dioxide. These fuels are collectively referred to as Renewable Gas (RG). (https://gridworks.org/wp-content/uploads/2019/09/CA_Gas_System_in_Transition.pdf, pg. 4)*

46 https://www.nrdc.org/sites/default/files/future-natural-gas-distribution-california-06062019.pdf. *The "No Building Electrification" scenario is defined as no electrification in buildings, high electrification of light-duty vehicles; in addition to using all available biomethane, adds hydrogen and synthetic gas in the pipeline and more zero emission vehicle trucks than high electrification scenario; pipeline gas blend remains 56% fossil in 2050, so a large share of the 2050 emissions budget is in buildings.*

47 https://www.nrdc.org/sites/default/files/future-natural-gas-distribution-california-06062019.pdf

The transition to all-electric buildings and systematic and managed reduction in gas infrastructure, if done equitably, will help to lower future increases in gas prices, reduce stranded assets (unused gas infrastructure that was installed but seldom used) and ensure that inclusive electrification opportunities are provided to customers who cannot afford to electrify on their own, so that they are not left behind with on a legacy system with higher gas rates.

HIGH QUALITY JOB GROWTH

High-road workforce development attempts to simultaneously improve the quality of and access to jobs. It is worker-oriented, seeking to invest in the development of human capital for the benefit of the climate, clean energy providers, consumers, and workers.[48] It is critical that building electrification includes opportunities, policies, funding and support systems to enable good quality jobs and access for under-represented workers and contractors as we transition to a high-road, low-carbon economy.[49] The transition to all-electric buildings will require work that will employ skilled and trained construction workers. This work includes electrical panel and wiring upgrades, weatherizing buildings, replacing appliances, energy efficiency, and installing batteries and solar photovoltaic power. This will also require planning strategies for a *just transition,* an equitable economic transition to carbon-neutrality that ensures there are opportunities for all, including workers that rely heavily on fossil fuel and the communities most burdened by the climate crisis.[50] This transition must be made in consultation with all crafts affected, including but not limited to sheet metal, electricians, carpenters, plumbers and pipefitters.

An Opportunity for High-road Jobs Creation

"High road" in a workforce context means an approach aimed at creating high-quality employment, "good jobs" characterized by family-sustaining, living wages, comprehensive benefits, and opportunity for career advancement.[51]

This provides an opportunity for the City to intentionally foster growth of high quality jobs that include family sustaining wages, benefits, safety, and security and worker representation to support a local, diverse, and skilled workforce to be part of a high-road economy. The City can encourage this transition through mechanisms such as workforce agreements, targeted strategies and worker

48 *Inclusive Economics, prepared for the American Cities Climate Challenge. "High-Road Workforce Guide for City Climate Action". March 2021. https://www.usdn.org/uploads/cms/documents/workforce-guide_4.12.21_form.pdf*

49 *https://greenlining.org/wp-content/uploads/2019/10/Greenlining_EquitableElectrification_Report_2019_WEB.pdf*

50 *https://climatejusticealliance.org/just-transition/*

51 *Inclusive Economics, prepared for the American Cities Climate Challenge. "High-Road Workforce Guide for City Climate Action". March 2021. https://www.usdn.org/uploads/cms/documents/workforce-guide_4.12.21_form.pdf*

skills requirements and labor standards tied to funding mechanisms, prioritized engagement with and strategies for workers with barriers to employment, and strategies to mitigate job loss. Ensuring high-road jobs for building electrification will require significant effort and support for employment of an inclusive unionized workforce, including smaller (low-rise) residential buildings which tend to be served by lower paid nonunion workers. A managed transition to electric buildings allows Berkeley to facilitate this job growth, ensuring historically disadvantaged communities can participate in the high-road workforce. As electrification expands to other cities in the region, this regional workforce with experience from Berkeley will have the knowledge and expertise necessary to work on the newest and most efficient technologies.

EQUITY

Electrification of Berkeley's existing building stock equates to the modernization of Berkeley's building stock. The electrification process has the potential to significantly improve the health, safety, cost effectiveness, resiliency, and comfort of Berkeley's homes and workplaces. Additionally, this transition creates an opportunity to improve some of the inequities that persist within Berkeley, especially in housing. Existing low-income housing tends to be older and less energy efficient, placing an unequal energy cost burden on low-income households and households of color who spend larger shares of their income on energy bills. Nationally and regionally, research demonstrates that African-American, Latino and low-income households and renters tend to pay more for electricity and gas service per square foot of building space.[52] As a result of this cost burden, many households cannot afford to pay for adequate heating and cooling, putting occupants at a higher risk of health complications associated with under-heated homes, (such as arthritis, rheumatism and respiratory complications) and health risks associated with homes without proper cooling (such as heat stroke, dehydration, and respiratory impacts).[53] This inequity is perpetuated by existing disparities in funding allocation for energy efficiency projects, which can favor more affluent homeowners.[54] Affluent consumers have a more opportunity to access and take advantage of existing programs and incentives. This inequality of participation amounts to the implicit subsidization of excess consumption, which is being financed by the general energy utility rate payer. The underlying design assumption behind the majority of these policy programs – that equality of availability will necessarily produce equality of participation – is fundamentally flawed. Estimates show that just 6 percent of national spending on electric energy

52 *https://assets.ctfassets.net/ntcn17ss1ow9/1UEmqh5l59cFaHMqVwHqMy/1ee1833cbf370839dbbdf6989ef8b8b4/Lifting_the_High_Energy_Burden_0.pdf*

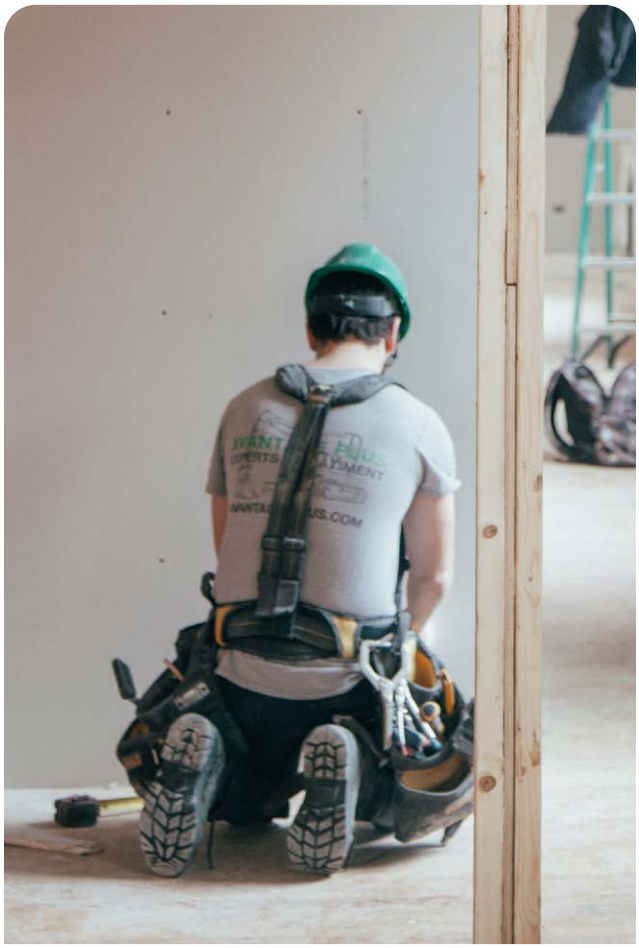
53 *https://climatenexus.org/climate-issues/health/extreme-heat/*

54 *https://online.ucpress.edu/elementa/article/doi/10.1525/elementa.419/112771/On-energy-sufficiency-and-the-need-for-new*

efficiency by utilities through their demand side management (DSM) programs was dedicated to low-income communities in 2015.[55]

Prioritizing electrification of older, inefficient buildings in low-income communities has the potential to enhance housing affordability and quality throughout Berkeley. Modeling demonstrates that most electrified homes retrofitted with heat pumps for heating and cooling use less energy and save on utility bills.[56] Complete electrification of all building appliances (including stoves and clothes dryers) have cost savings when paired with solar as described further in Chapter 3. Furthermore, savings may be magnified when electrification is paired with upgrades to a building's energy efficiency, such as improved weatherization or replacement of windows. Finally, there are also the many non-financial benefits such as health, safety, and comfort, which should be considered on top of the financial analysis.

However, there are costs associated with modernization. Electrification will be an investment in Berkeley's future, but care will be needed to ensure that the upfront costs of this work are equitably–not equally–distributed across the community. To ensure that existing building electrification does not increase the burden on vulnerable communities, Berkeley has put equity at the very center of the electrification discussion, by prioritizing the needs and voices of historically marginalized communities in the process and outcomes, and utilizing the Equity Guardrails to ensure future programs and policies are equitable.[57] Chapter 2 includes the full analysis of Berkeley's current equity challenges and opportunities as they pertain to existing building electrification. Additionally, Chapter 2 summarizes the study's outreach and engagement which led to the development of the Equity Guardrails that refined the Strategy and its associated actions.



55 *https://www.edf.org/sites/default/files/documents/liee_national_summary.pdf*
56 *https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf*
57 *A full discussion of who these communities are and how they were included in the planning process is included in Chapter 3.*

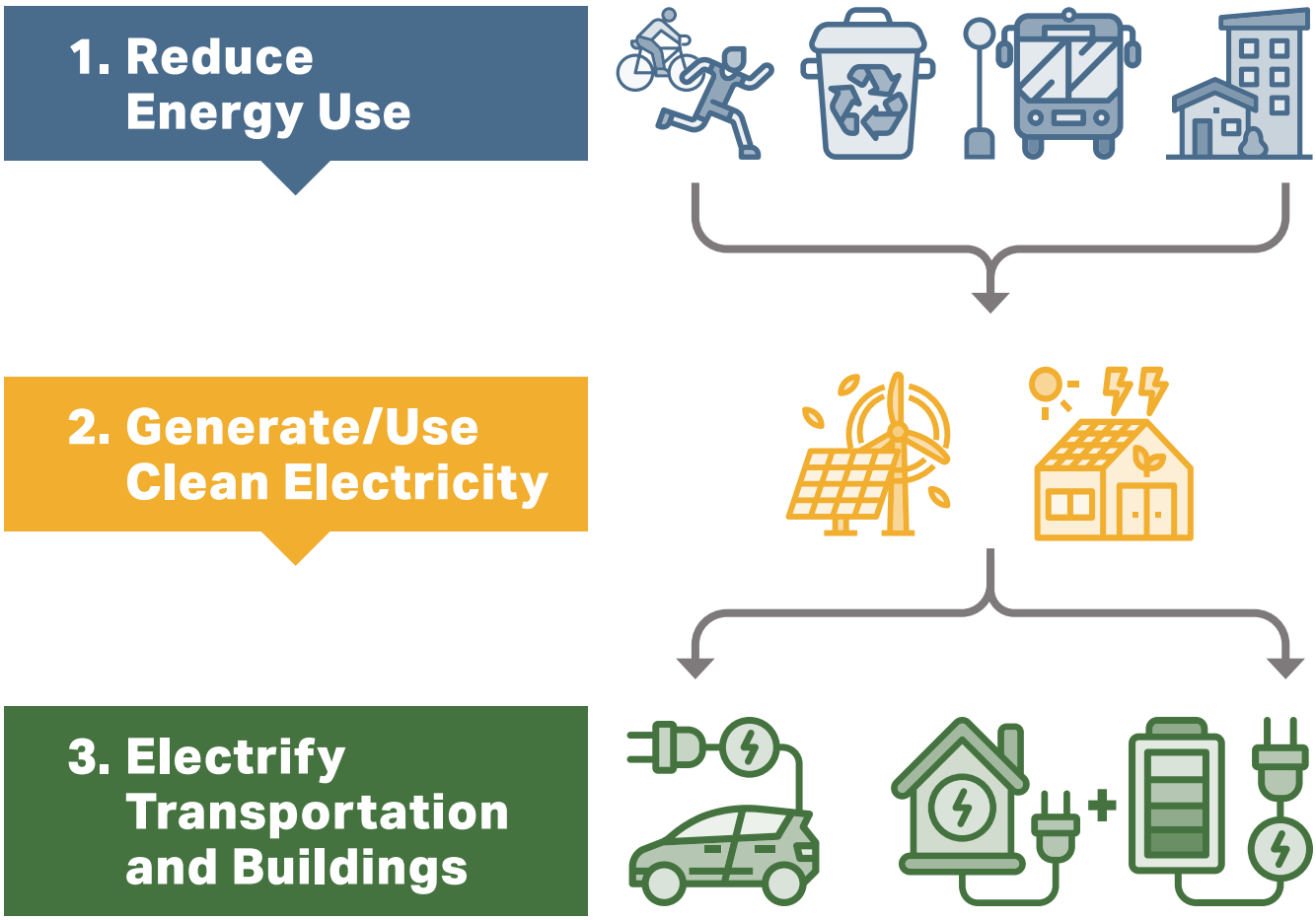
1.2 PURPOSE AND GOALS OF THE STRATEGY

The purpose of Berkeley's Strategy is to analyze the existing building stock of the City, with a focus on low-rise residential, and identify potential pathways for an equitable transition to all-electric buildings. This transition includes replacing gas burning appliances and equipment in existing buildings with high-efficiency electric powered versions. The Strategy is based on an in-depth analysis of Berkeley's building stock and a building-by-building energy model that was used to assess the likely scale of fuel switching process as well as the associated costs (Chapter 3). Based on these results, Berkeley solicited feedback from a wide variety of stakeholders and community members who helped develop Equity Guardrails to ensure Berkeley's pathway to all-electric buildings not only avoids negative impacts to equity, but strives to improve current conditions (Chapter 2). Based on modeling results and feedback from the community, this report lays out a high-level long-term strategy as well as specific actions, policy changes, and funding mechanisms that Berkeley and other entities can implement or advocate for at the State level (Chapter 4).

1.3 BERKELEY'S ELECTRIFICATION GOAL

Berkeley's path to a clean energy future, free of fossil fuels, is first to reduce the energy used in our buildings and vehicles through efficiency, then clean the source of electricity to be zero emissions and renewable, and then finally to electrify our buildings and transportation by transitioning away from fossil fuels to clean electricity.

Figure 1-5. Berkeley's Decarbonization Strategy



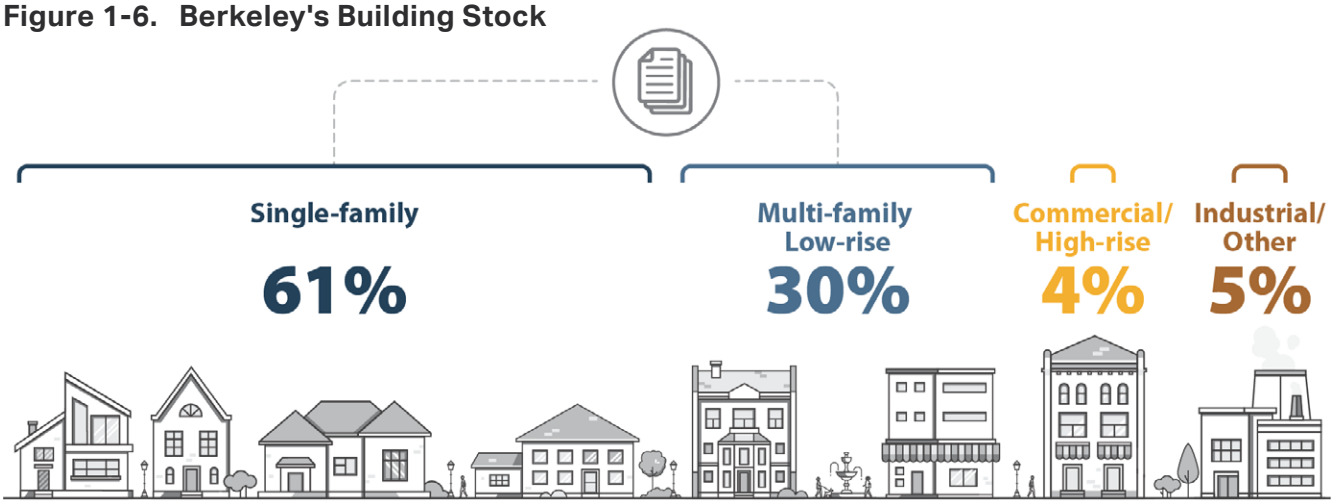
The electrification of every building in the City will require a momentous effort, including shifts in financing solutions, funding mechanisms, utility regulation, housing protection, education, and workforce training. The purpose of this study is to identify an equitable and effective path forward, taking potential issues into consideration and determining which programs should be developed and prioritized to ensure an equitable distribution of the costs and benefits associated with electrifying Berkeley's building stock. While the technology exists today, electrifying Berkeley's existing buildings in an equitable manner that does not impose additional financial burden on the Berkeley community will require addressing the upfront costs associated with modernization. The potential issues associated with this change are actively being addressed though this study, but it will take time and collaboration to develop the necessary funding, financing, regulatory, and educational mechanisms to make this process a success. The City can and will continue to take action and begin the transition to fossil fuel-free buildings guided by the Equity Guardrails. A complete timeline for implementation is outlined in Chapter 4 of this Strategy.

Based on the cost analysis and community feedback, the Strategy sets the goal to begin enabling this transition immediately, and to complete electrification of all buildings no later than 2045. The phased approach provides flexibility, and attempts to balance the urgency of the climate crisis with the need to ensure electrification can be scaled to reach all communities equitably. The phases may have some overlap, and the target years serve as guides that may move more quickly with technological, regulatory, or financial advances. This timeline allows for deep consideration of equity into all future programs and allows for all the necessary programs and policies to be put in place, many of which are outside Berkeley's direct control. Without adequate time for planning the transition to all-electric buildings, the risk increases for a further divide between those who can afford to electrify and those who cannot, and inadvertent displacement and other negative impacts to the communities that stand to be helped the most through electrification. As momentum builds across the State and additional funding and financing becomes available, this Strategy may be implemented faster, but will continue to be vetted through the Equity Guardrails and with feedback and engagement with the community.

1.4 FOCUS AREAS

The Strategy focuses primarily on Berkeley's most common building type, residential buildings under four stories. According to Figure 1-6, over 90 percent of Berkeley's buildings fall under this definition. Other buildings like residential mid- and high-rise, as well as commercial and industrial buildings were not included in the analysis conducted for this Strategy due to lack of available data and inability of the core building model to run analysis on commercial building stock.[58] The Strategy is based on a building-by-building analysis of what is needed to retrofit each of the included buildings, including assessment of the age and history of retrofits, which was collected through historic permit data. This analysis guides the identification of types of the most cost-effective retrofit packages and investigates the costs and funding mechanism that will allow for full electrification. A detailed explanation of Berkeley's building stock and the analysis conducted can be found in Chapter 3, and in Appendix A.

Figure 1-6. Berkeley's Building Stock



While electrification of existing residential buildings over four stories and commercial and industrial buildings were not included in this Strategy, additional work is currently underway to identify the most cost-effective ways to electrify or otherwise decarbonize these building types as well. Lawrence Berkeley National Laboratory is currently working on additional analysis on the opportunities available to decarbonize larger residential and commercial buildings whose systems may differ from and be less uniform than the low-rise residential stock.

58 *The analysis largely relies on the ResStock Model and the Radiant Labs tool. At the time of this report, ComStock, the commercial energy model was not integrated into Radiant Labs.*

2. ACHIEVING EQUITABLE BUILDING ELECTRIFICATION

Electrification of existing buildings – the places where we live, work, play, and connect – provides an opportunity to focus not just on upgrading the buildings themselves, but also centering the conversation on the people who inhabit them, especially on those who have been historically marginalized. Beyond changing out appliances and building systems, electrification provides an opportunity to re-think and reform policies in order to make our homes and workplaces healthy, safe, sustainable, and affordable for the people who reside in them, and to correct inequities in our current socioeconomic systems. Housing and the jobs tied to building and maintaining them are important parts of people's quality of life and significant policy changes require careful forethought to avoid unintended consequences or overly burdening communities that have been historically marginalized. Therefore, throughout this project, the City engaged with individuals and representatives of communities of color, low-income, senior, and disabled communities throughout Berkeley to better understand the relevant concerns and opportunities and provide a forum for shared learning, trust-building, and collaboration.

This chapter defines the key concepts that have informed the team's approach and then identifies the priority communities who may be impacted most by electrification policies. It then presents potential risks and opportunities associated with building electrification that have been identified through engagement with the community.

2.1 DEFINING EQUITY

Berkeley's Strategy takes an approach to equity that centers on people and prioritizes strategies that will enable outcomes that benefit historically marginalized communities. For the purpose of this Strategy, consistent with the Greenlining Institute, equity means "increasing access to power, redistributing and providing additional resources, and eliminating barriers to opportunity, in order to empower low-income communities of color to thrive and reach full potential" and includes "transforming the behaviors, institutions, and systems that disproportionately harm people of color."[58] This recognizes that privilege is not shared equally, and that in order to achieve equal outcomes, more dedicated resources must be allocated to address societal inequities.

Applying this definition to electrification of existing buildings means that all people must have affordable access to the health, comfort, economic and resilience benefits of building electrification – and that marginalized communities and communities most impacted should be prioritized. This also requires intentionally lifting voices and needs of those who are usually not represented in policy development, and redesigning policies if they don't actually benefit frontline communities, even if it upends a pre-conceived goal.

In order to ensure a comprehensive approach of applying equity to this work in support of Berkeley's marginalized communities, the team used the Kapwa Consulting [59] framework which focuses on three primary areas:

- Procedural equity is about a fair and inclusive process that centers on those who are most impacted by policies or have had to bear the most burdens of inequities, in order to make better decisions and better policies. For this project, this meant that the team held intentional, targeted conversations with community organizations and representatives to ensure their voices informed the policies. This inclusive outreach resulted in the equity guardrails (Chapter 2.5) which reflect the priorities and concerns of marginalized communities, highlighting the need to protect people against potential unintended consequences of building electrification like gentrification, displacement and other concerns.[60]
- Distributional equity is about how outcomes can differ depending on the community.

58 *https://greenlining.org/publications/reports/2019/making-equity-real-in-mobility-pilots-toolkit/#:~:text=Equity%20means%20increasing%20access%20to,thrive%20and%20reach%20full%20potential.*

59 *https://www.kapwaconsulting.com/*

60 ***Gentrification:*** *a process of neighborhood change that includes economic change in a historically disinvested neighborhood–by means of real estate investment and new higher-income residents moving in–as well as demographic change–not only in terms of income level, but also in terms of changes in the education level or racial make-up of residents.*
Residential Displacement ("Displacement"): *the process by which a household is forced to move from its residence–or is prevented from moving into a neighborhood that was previously accessible to them because of conditions beyond their control.*
https://www.urbandisplacement.org/resources

Policies can create a range of benefits, burdens, and exclusions. Distributional equity does not mean equality (where everyone gets the same thing), but rather that people define their own needs, and those who are least able to bear the costs of a policy do not incur them, while those in most need of the benefits of a policy are able to receive them. An example of how the team addressed distributional equity in this project was to question "who is burdened, who benefits, and who is left out?" throughout the process. In prioritizing the needs of marginalized communities, policies that were deemed to have financial or other burdens were made contingent on the establishment of supporting systems to ensure accessibility and inclusivity. This approach resulted in the phasing of mandatory policies to be contingent on funding and financing programs and a focus on making sure renters, who make up approximately 57% of Berkeley residents, share in the benefits of electrification.

- Structural (intergenerational) equity is about changing systems and paying attention to the ways they intersect. Addressing structural equity requires commitment and dedication to build trust within the communities who have endured past harms from the government and including those communities as partners in creating solutions. To support this shift, the project embedded equity as a core principle from the onset, partnering with the Ecology Center, a local nonprofit organization that has long-standing relationships with grassroots organizations. The team dedicated a significant amount of the overall project resources and funding to community engagement with traditionally under-represented communities and considered how to undo the damages of redlining and exclusive zoning in the proposed recommendations. Support for and continued partnership with representatives from marginalized communities will be key to finding approaches that include all buildings and benefit all the people in them to improve resiliency and eliminate greenhouse gas emissions.

TARGETED UNIVERSALISM

In order to assure that all buildings in Berkeley can eliminate gas, the policies will need to be designed to meet the needs of everyone, including communities who have been historically marginalized and who stand to benefit the most from electrification. And because everyone has different needs, backgrounds, and lived experiences, it is essential to develop strategies targeted to different needs rather than using a "one size fits all" approach.

To design intentional policies that lead to equitable outcomes, the team utilized the Targeted Universalism framework developed by the Othering & Belonging Institute at UC Berkeley. At its core, Targeted Universalism is the practice of setting a universal policy goal (for example, electrifying all existing buildings) while identifying targeted strategies and actions specifically for marginalized communities to ensure that those communities can benefit from the policy goal. As opposed to the concept of Market Transformation that assumes benefits can be evenly distributed by supporting innovation for well-resourced homeowners, targeted universalism starts with the concept that by addressing the needs of the least resourced everyone will share the benefits. As detailed in the Haas Institute Primer on Targeted Universalism,[61] each "policy is tailored to the needs of the people it aims to serve or protect." For example, a targeted universalism approach to renewable energy would explore the relative benefits of rooftop solar, community-scale solar, and other strategies for ensuring that marginalized communities will get access to affordable, renewable, energy. Using this framework for the Strategy means that although there is a common goal across the community of transitioning buildings and the energy system off of fossil fuels, in order to succeed at a community-scale there will need to be varying approaches and resources offered depending on which segment of the community is being targeted. As the City begins to implement the actions identified in this strategy, ongoing engagement will be critical to ensuring authentic use of the targeted universalism framework. As more specific policies and programs are developed this framework will continue to help the City work towards equitable outcomes.

61 *https://haasinstitute.berkeley.edu/system/tdf/targeted_universalism_primer.pdf?file=1&force=1*

GREENLINING INSTITUTE'S EQUITABLE BUILDING ELECTRIFICATION FRAMEWORK

The Greenlining Institute's Equitable Building Electrification Framework addresses the engagement opportunities and challenges that electrification presents for low-income communities.[62] This five-step framework served as a guide to the City on how to ensure the engagement process was equitable and supported the community's stated goals of resiliency, high quality local jobs, and making housing safer and more affordable. The five steps are:

STEP 1: Assess the Communities' Needs

STEP 2: Establish Community-Led Decision-Making

STEP 3: Develop Metrics and a Plan for Tracking

STEP 4: Ensure Funding and Program Leveraging

STEP 5: Improve Outcomes

Based on this suggested framework, the City began the process by assessing community needs and establishing a community engagement process to solicit feedback and contribute to decisions related to existing building electrification policies and timeline for implementation. The additional steps of developing metrics for tracking of implementation and ensuring funding and leveraging of existing programs are included as future actions in Chapter 4. The final step of improving outcomes will come with the implementation of this Strategy. As these steps are iterative, the City continues to make progress and will continue to utilize this framework throughout implementation of the Strategy.

62 *https://greenlining.org/publications/reports/2019/equitable-building-electrification-a-framework-for-powering-resilient-communities/*

2.2 DEFINING MARGINALIZED COMMUNITIES

The idea of Targeted Universalism is to collaboratively unite behind a common goal (in this case, complete building electrification) where strategies such as programs and policies are targeted towards specific groups, based upon how different groups are situated within structures, culture, and across geographies to obtain the common goal.[63] This process necessitates identifying specific population groups and analyzing impacts and resource needs for each group. While the number of population groups and sub-groups of people within a community could be almost infinite, through our stakeholder engagement, the team identified certain communities that have been historically marginalized in Berkeley and who should benefit most from the policies proposed in this Strategy. These communities include Black, Indigenous, Communities of Color (BIPOC), low-income communities, people living with disabilities, non-English speaking communities, immigrants, refugees, seniors, young children, the LGBTQ community, and other people groups who have been historically marginalized, under resourced and/or have experienced procedural, distributional, and structural inequalities. A distribution of race for Berkeley shows that almost half of the population is BIPOC. Areas that were originally redlined in Berkeley now see the highest levels of displacement and gentrification.

63 *https://belonging.berkeley.edu/targeteduniversalism*

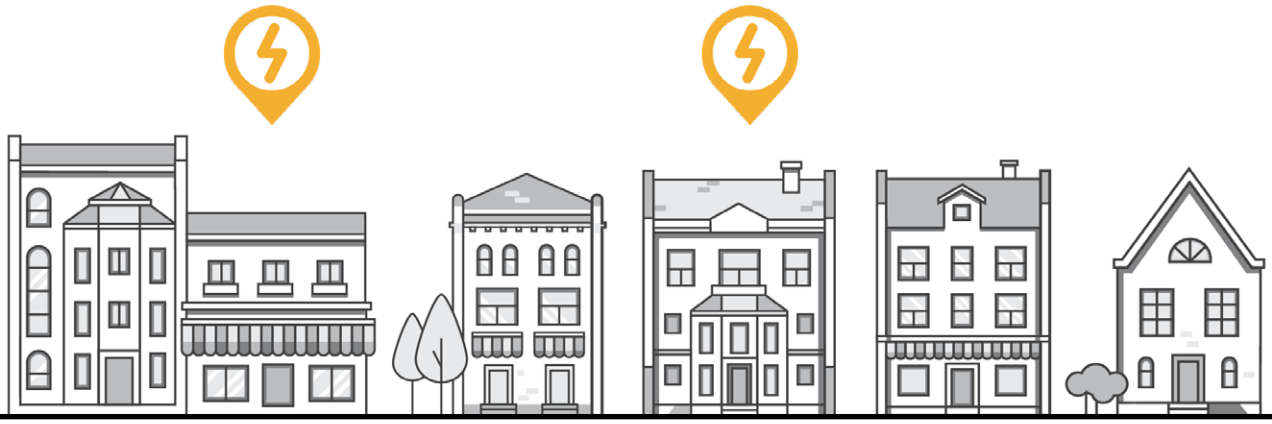
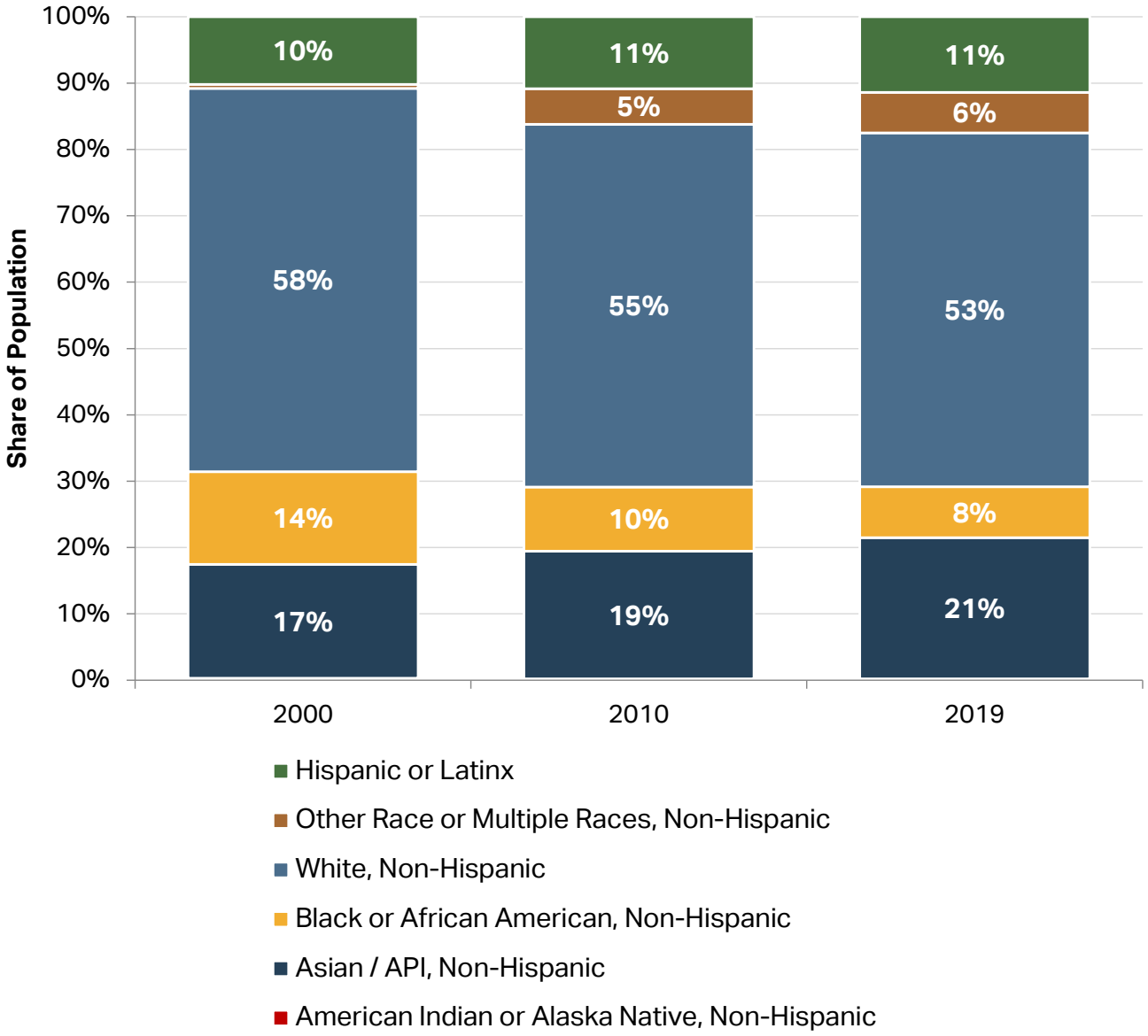


Figure 2-1. Berkeley Population Distribution by Race[64]



Between 2000–2019 the number of African American residents in Berkeley declined by over 40%

64 *Data from Association of Bay Area Governments Housing Element Data Package*

WHY WE LEAD WITH RACE

Consistent with the Government Alliance on Racial Equity (GARE), the equity analysis for this Strategy leads with race and recognizes racial inequities have been created and perpetuated by government, and that across all indicators of success, racial inequities are deep and pervasive. Additionally, focusing on racial equity provides the opportunity to introduce a framework, tools and resources that can also be applied to other aspects of marginalization.[65] Historically racist and discriminatory practices such as slavery, Jim Crow laws, racially restrictive covenants, and redlining have been banned, but they have resulted in severe and lasting impacts on communities of color.[66]

For example, due to the persistent legacy of discriminatory housing policies, low-income families of color were denied opportunities to build wealth and are more likely to live in substandard housing with faulty heating or cooling and poor insulation that is unhealthy, unsafe, and results in higher utility bills.[67] Historically, communities of color with Berkeley have been explicitly discriminated against when it comes to housing. Berkeley has a long history of racial housing discrimination and was the first city to enact single family zoning in 1916, which largely segregated the City early on. Redlining mapped out areas of the city by race. The areas with high populations of people of color were then "redlined", and those areas were not eligible for Federally backed Home Owner Loan Corporation guaranteed mortgages, as shown in red in the Thomas Bros map (Figure 2-2). Banks then denied loans, refinancing, and mortgages to property within these redlined areas, preventing people of color from buying homes, one of the main ways people can build generational wealth in America. Impacts from these discriminatory practices are still felt today in patterns of segregation as well as harms to health and wealth to people of color in Berkeley.[68]

According to a report by ACEEE in 2020, low-income, Black, Hispanic, and Native American households all face dramatically higher energy burdens—spending a greater portion of their income on energy bills—than the average household.[69] High energy burdens are correlated with greater risk for respiratory diseases, increased stress and economic hardship, and difficulty in moving out of poverty. These communities also experience acute systemic inequalities, barriers, and limited access to public and private resources, and they are now being hit the hardest by job losses and health impacts of the pandemic. It is therefore important to elevate the voices and priorities of these communities who are impacted first and worst by climate change.

65 *https://www.racialequityalliance.org/about/our-approach/race/*

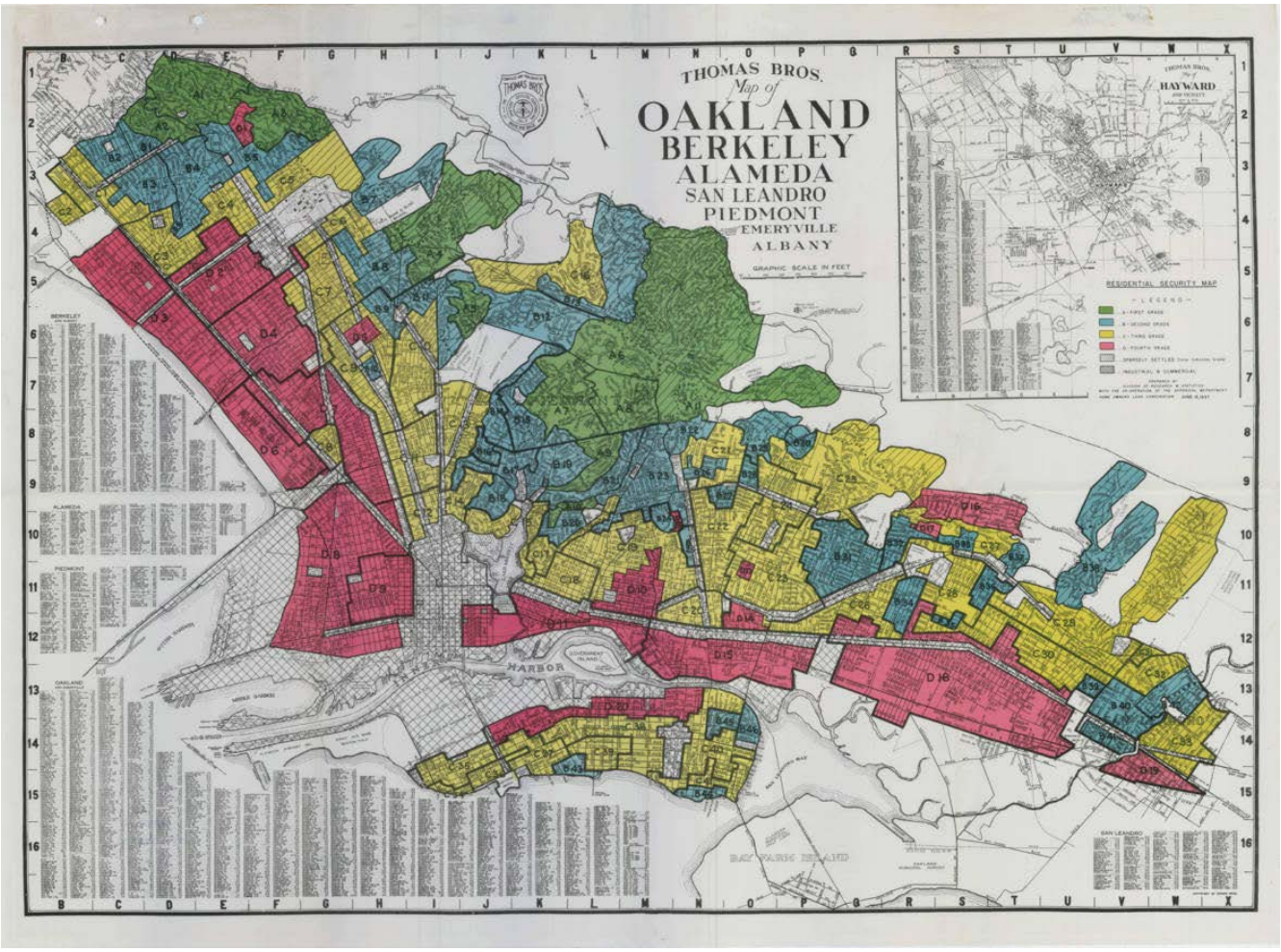
66 *Simpkin, Noel. "Resilience for All: Applying an Equity Lens to Berkeley's Seismic Transfer Tax Rebate Program". May 2020. https://www.cityofberkeley.info/Clerk/City_Council/2020/07_Jul/Documents/2020-07-21_Special_Item_03_Referral_Response_Ordinance_pdf.aspx*

67 *The Utility Reform Network (TURN): https://www.aceee.org/research-report/u2006*

68 *https://www.berkeleyside.com/2018/09/20/redlining-the-history-of-berkeleys-segregated-neighborhoods*

69 *https://www.aceee.org/energy-burden*

Figure 2-2. Berkeley's History of Redlining[70]

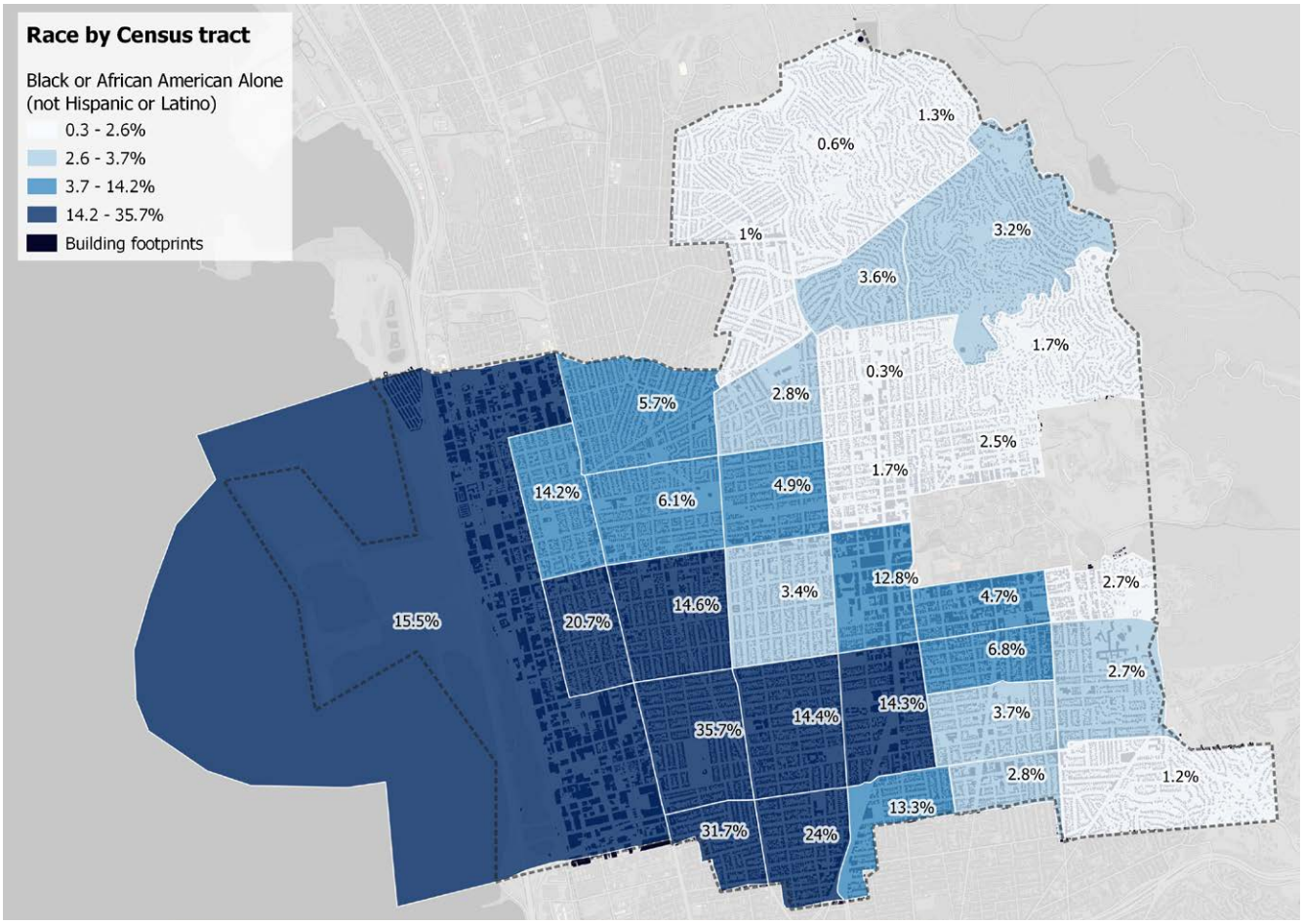


Today, communities of color are suffering the highest rates of displacement and the neighborhoods which had been historically redlined are now the most heavily impacted by gentrification. Gentrification and displacement are occurring in these areas specifically because they were under-invested for so long, and as housing prices have increased significantly, those who can afford to rent or buy (typically wealthier, White people) raise property values, and the people of color are pushed out.

To illustrate the current impacts of these policies, the following maps illustrate present day indicators associated with exclusionary policies. Figure 2-3 shows the census tracts where Black or African American people currently live in Berkeley, a map that largely aligns with the redlined areas in Figure 2-2.

70 *University of Virginia, Mapping Inequality:* https://dsl.richmond.edu/panorama/redlining/

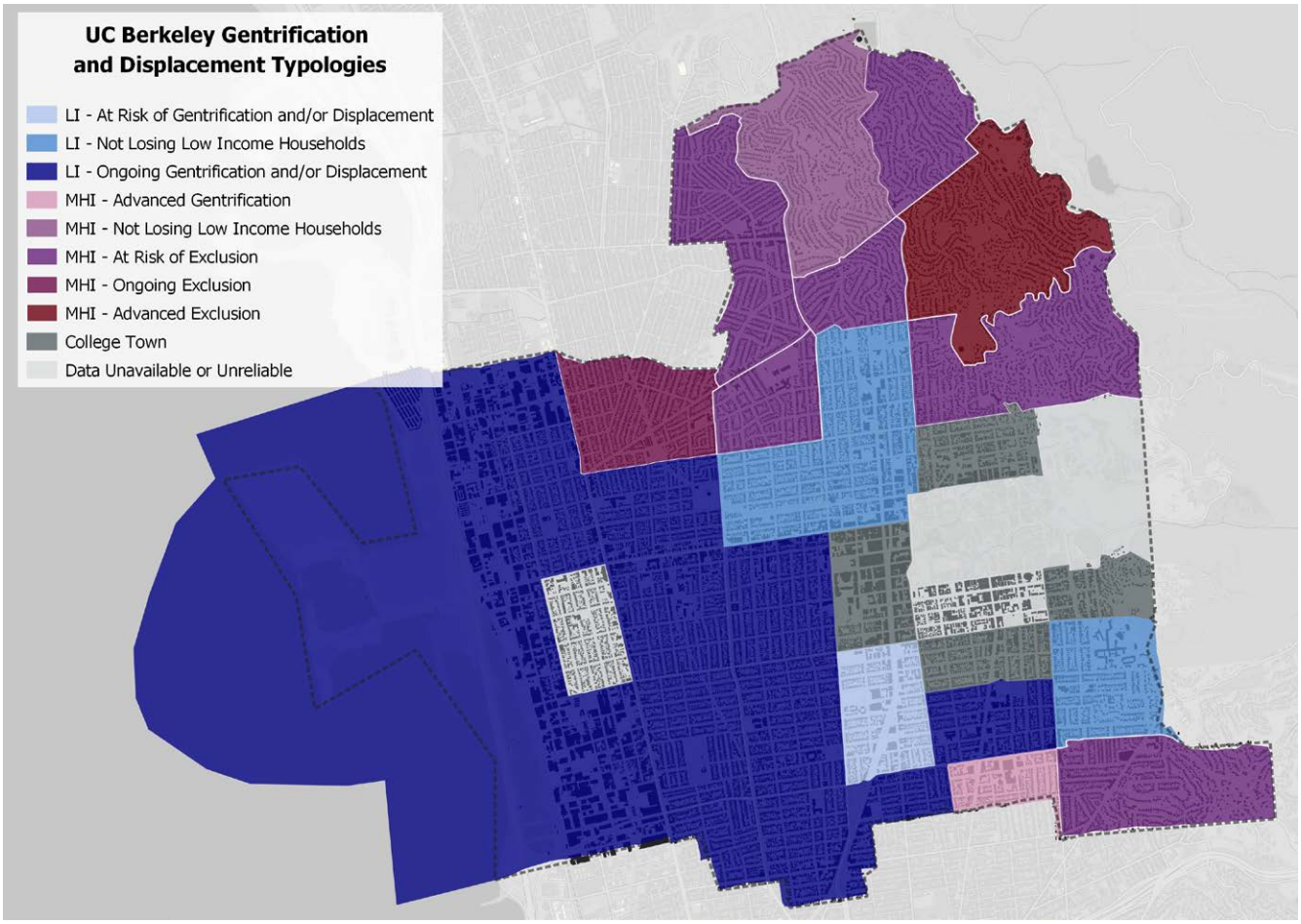
Figure 2-3. Race by Census Tract in the City of Berkeley[71]



These same areas now see higher rates of gentrification (Figure 2-4) and lower incomes (Figure 2-5).

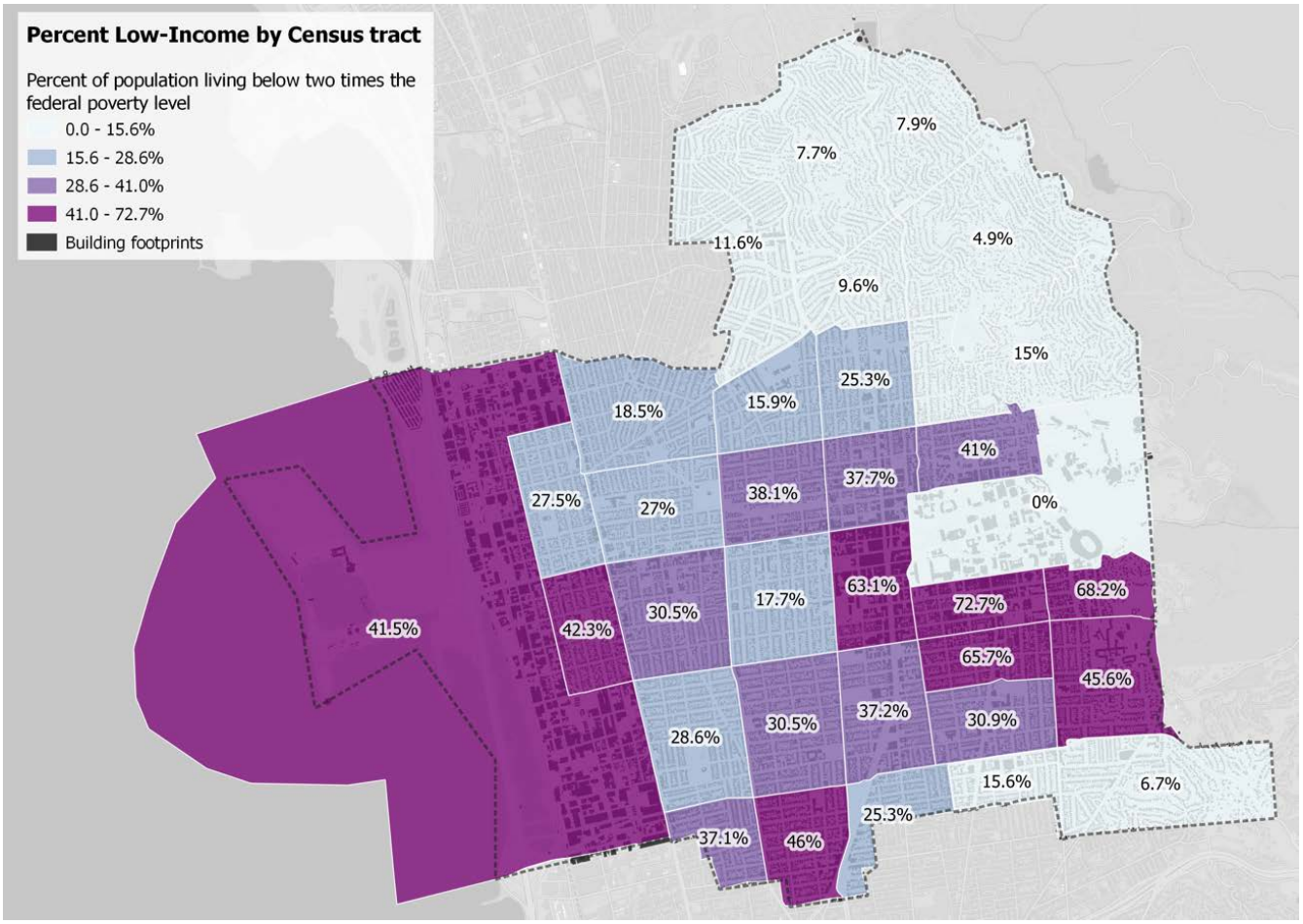
71 *Based on Census Bureau, American Community Survey 5-year estimate for 2017. Map developed by the Building Electrification Institute.*

Figure 2-4. Gentrification and Displacement Rates City of Berkeley[72]



72 *Urban Displacement Project. Based on Census Bureau, American Community Survey 5-year estimate for 2017. Map developed by the Building Electrification Institute.*

Figure 2-5. Percent Low-Income by Census Tract[73]



Between 2000 and 2010 the largest change to Berkeley's ethnic diversity was the decline in its African American population (from 13.3 percent in 2000 to 9.7 percent in 2010)[74] – and this trend has continued in recent years, largely due to gentrification and displacement. The change is even more pronounced in South and West Berkeley: between 2000 and 2017 the number of African American residents declined by 40 percent. This trend is not only impacting the diversity of Berkeley, but also highlights the continual disenfranchisement of people of color.[75]

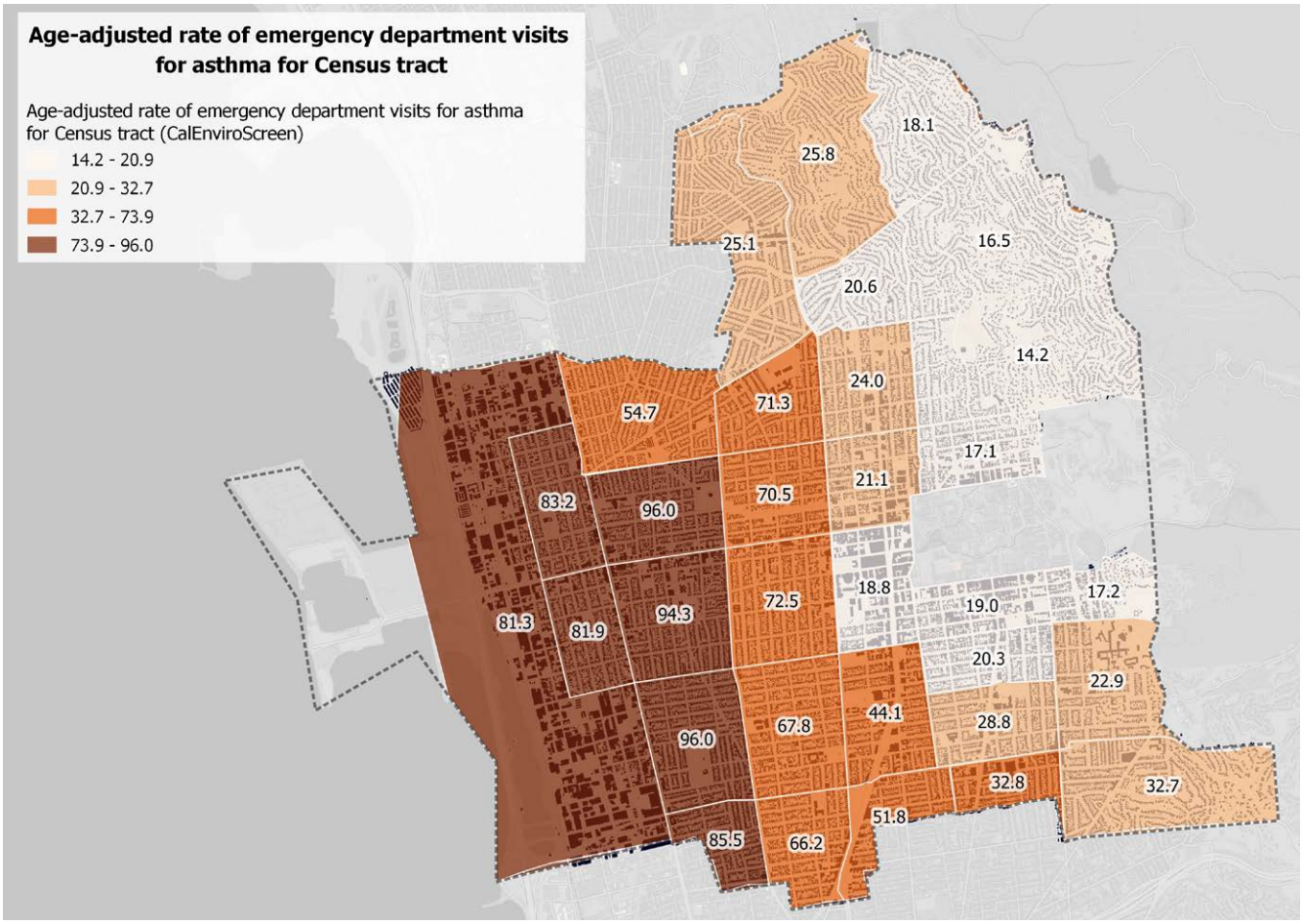
73 *Based on US Department of Health and Human Services, 2019 Poverty Guidelines. Map developed by the Building Electrification Institute.*

74 *City of Berkeley Housing Element 2015*

75 *Simpkin, Noel. "Resilience for All: Applying an Equity Lens to Berkeley's Seismic Transfer Tax Rebate Program". May 2020. https://www.cityofberkeley.info/Clerk/City_Council/2020/07_Jul/Documents/2020-07-21_Special_Item_03_Referral_Response_Ordinance_pdf.aspx*

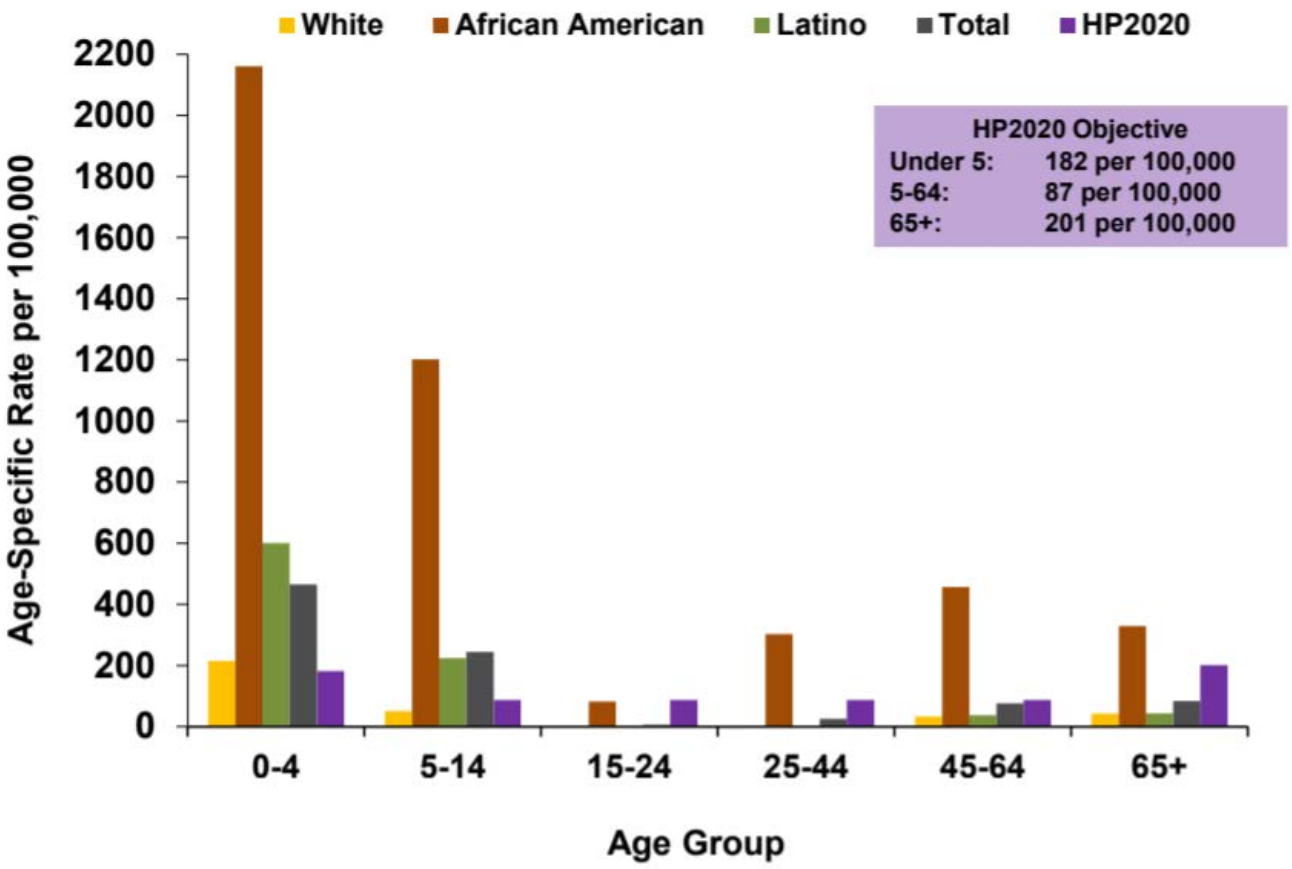
These same Black and African American communities are also experiencing adverse health impacts as shown in Figure 2-6 and Figure 2-7. As seen in these maps, these health outcomes are correlated with inadequate housing, degraded air quality given West Berkeley's proximity to the I-80 freeway, and other environmental factors prevalent in these communities due to historically low investment driven by deep-rooted racist policies.

Figure 2-6. Age Adjusted Rate of Emergency Department Visits for Asthma by Census Tract[76]



76 *Data from CalEnviroScreen. Map developed by Building Electrification Institute.*

Figure 2-7. Age-Specific Asthma Hospitalization Rate by Age Group and Race/Ethnicity in the City of Berkeley (2012-2014)



Source: City of Berkeley Public Health Division, Epidemiology & Vital Statistics; Office of Statewide Health Planning and Development, 2012–2014

Recognizing the impacts that race has on the socioeconomic and health impacts discussed above, the community engagement approach included, but was not limited to, people of color as a priority marginalized group. The City will continue to work with all communities to further establish the targeted approaches required for successful implementation of the Strategy.

2.3 COMMUNITY ENGAGEMENT APPROACH

Two core priorities of this Strategy development were to 1) center equity, and 2) build community trust and relationships. To achieve these goals, in late 2019 to early 2020 staff from the Ecology Center, a trusted partner within the community began outreach efforts as an intermediary on behalf of the City by meeting with local community leaders and organizations that represent marginalized communities to build trust, gather information on how to engage the larger community, and to get initial feedback on building electrification. This targeted outreach was intended to raise up community voices who have not been historically represented in City policy development.

Next, the Ecology Center connected City staff with interested community contacts so that the City could continue relationship-building even without the Ecology Center as a necessary part of the interactions. Jointly, the City and the Ecology Center continued to meet with community organizations and community leaders throughout the project, and the hope is that these meetings and relationships will continue.

In addition to these one-on-one meetings with community organizations, the City also hosted an equity-focused community meeting with community organizations in November 2020. This intentional and focused engagement helped to inform and impact the strategy development timeline, structure of the engagement with the broader community, and recommendations.

Beyond the direct, targeted outreach with the community groups, the City also conducted more traditional outreach with leading technical experts, policy experts, and other jurisdictions in order to inform the strategy, including:

- Met with several other Departments within the City to collaborate and dovetail with related work
- Convened a Building Emissions Saving Ordinance (BESO) Technical Advisory Committee (March 2020)
- Convened a Strategy Technical Advisory Committee Meeting with nearly 70 attendees including technical experts, contractors, policy experts, and other local jurisdictions (September 2020)
- Presented to the Berkeley Energy Commission (January 2021, April 2021)
- Convened a public forum to provide input on the Draft Strategy (May 2021)

DEFINING SUCCESSFUL OUTREACH AND ENGAGEMENT

In order for outreach and engagement to be considered equitable, it should affect both the decision-making process and the policy decisions based on what was heard in the community. The community engagement for the Strategy was robust and in-depth but instead of measuring factors such as number of people attended or number of meetings, the more important community engagement metrics of success are the relationships that were established and continued, the quality of information received, and the depth to which that information was integrated into electrification policy recommendations.

The equity-focused community engagement feedback had significant impacts on the outcomes of the Strategy including determining what types of electrification policies could be required, a timeline for when these policies could be implemented, who will be affected, and how to ensure that costs are not concentrated on those least able to afford them and that benefits are experienced by those who need them most.

Community Groups Engaged With During Strategy Development

The community organizations representing marginalized communities that participated in engagement for this Strategy include:

- Accessible Climate Strategies
- African American Holistic Resource Center
- Asian Pacific Environmental Network (APEN)
- Bay Area Hispano Institute for Advancement, Inc. (BAHIA)
- Berkeley Black Ecumenical Ministers Alliance (BBEMA)
- Berkeley Rent Board
- Building and Construction Trades Council of Alameda County (BTC Alameda)
- California Housing Partnership Corporation (CHPC)
- Center for Independent Living (CIL)
- Church By the Side of the Road
- Citizens for a Better Environment
- Coro Northern California
- East Bay Clean Power Alliance (EBCPA)
- Easy Does It
- Energy Democracy Project
- Friends of Adeline
- Green the Church
- Greenlining Institute
- Healthy Black Families
- International Brotherhood of Electrical Workers (IBEW) 585
- La Peña
- Local Clean Energy Alliance (LCEA)
- McGee Avenue Baptist Church
- Plumbers and Steamfitters 342 (UA 342)

- Rebuilding Together
- Resources for Community Development (RCD)
- Rising Sun Energy Center
- Satellite Affordable Housing Associates (SAHA)
- Sierra Club
- Urban Habitat
- World Institute on Disability

Feedback from these groups brought attention to community-specific concerns, needs, priorities, and considerations regarding electrifying existing buildings, which are summarized below. This feedback informed the final outcomes of the Strategy and informed the creation of the equity guardrails that are discussed further in Chapter 2.5.

2.4 IDENTIFIED EQUITY CONSIDERATIONS

Several themes emerged during discussions with community groups and nonprofits serving marginalized communities, and directly informed this Strategy. While ongoing conversations will continue, a summary of some of the feedback heard to date from our equity outreach can be found below. Please note these comments represent opinions and feedback from community members.

Cost Concerns

People expressed strong concerns of any increased costs for residents, especially renters and low-income homeowners who cannot afford new electric appliances, associated accessories to use them (i.e., new pots and pans for induction stoves), and any potential increase to utility bills.

- Energy insecurity impacts 25% of California families.[77]
- If gas prices are rising, we need to be sure to protect the low-income community that stays on gas from bill spikes.
- Do not mandate electrification if people cannot afford it. Electrification doesn't matter if people can't pay their bills.
- Make sure financing options do not increase debt–we do not want to offer a loan where people have to take a lien out on their house for the few homeowners of color left.
- Ensure that affordable options are also high quality options and solutions.

77 *The Utility Reform Network (TURN), http://www.turn.org/wp-content/uploads/2018/05/2018_TURN_Shut-Off-Report_FINAL.pdf*

Concerns of Displacement and Housing Affordability

People expressed strong concerns about needing to protect renters and long-term homeowners from displacement and to ensure that building electrification efforts do not further perpetuate displacement, gentrification and the affordable housing crisis.

- There is a need to address the split incentive between landlords (who would have to pay for the upgrades) and tenants (who would benefit from the upgrades, but could be pushed out in order for the landlord to recoup costs and increase rents). Protect renters so landlords can't raise rents, evict, or in other ways push tenants out of their homes.
- Ensure electrification retrofit costs cannot be passed on to renters, which could lead to displacement. Short-term displacement during retrofits should be covered for low-income community members.
- Concern that electrification will limit the creation of additional affordable housing.

Electrification Can and Should Be Linked With Other Needed Building Upgrades

People expressed that many of Berkeley's buildings, especially income-qualified buildings, are in substandard condition and have many physical upgrade needs for health, safety, and comfort beyond electrification that also need to be addressed and prioritized (such as mold treatment, lead, asbestos, and earthquake retrofits).

Need for Energy Reliability

People expressed that the community is concerned about the reliability of electricity, especially with increased Public Safety Power Shutoff (PSPS) events from PG&E. As we are seeing more frequent and consistent occurrences of PSPS events, and climate change will lead to more extreme weather conditions that could lead to these events, people expressed the need for reliable energy assurance. Some felt that having gas provided redundancy, even though many gas appliances will not work during an electrical outage.

- This is particularly relevant for disabled communities who need electricity to power equipment/wheelchairs, refrigerate medicine, and more.
- Energy supply should be localized and stored through solutions such as solar + battery storage, community microgrids, and resilience hubs.

The City and Others Need to Lead by Example and Build Trust

People expressed that there is a lack of trust with the government, and a history of lack of follow-up. Culturally sensitive education can help build trust in the technology and benefits. We also heard that in order to build trust in electrification, other larger entities like the City, private companies, and other trusted organizations should lead by example by electrifying their buildings first to prove the benefits, safety and feasibility before asking others to do so.

Need for Culturally-Sensitive Education to Address Steep Learning Curve

People expressed that there is a high need for culturally-sensitive communication, education, and technical assistance around electrification as this is a new topic for many community members, and people want to learn more about the benefits and technology. The City should acknowledge and address varying methods and styles of learning/understanding and seek to meet people where they are.

- Specifically, cooking is a cultural asset, and many feel strongly about cooking with gas stoves. Cooking helps bring community together and food plays an important part in both tradition and culture-making, any disruption to that will need to be addressed thoughtfully and with cultural sensitivity. This will need to be discussed and focused on in the transition, and people of color need to lead the way in education.

Programs and Benefits Need to Be Accessible to All

People expressed that the health, safety, comfort and resilience benefits of electrification, including high quality equipment and renewable energy powering the equipment, should be accessible and affordable to all.

- Existing programs have challenges that need to be addressed including not enough rebates, long wait lists for assistance programs, and primarily benefiting the privileged, leaving no money for those who are disadvantaged.
- Concern that some people such as immigrants may not want to disclose personal information required to access rebates or programs (such as in solar rebates), so ensure programs are accessible to these groups.

The City Needs to Collaborate Closely With Community and Others on Solutions

People expressed that the City needs to work closely with the community to co-create solutions through direct outreach and meeting people where they are, including those from minority groups and those who cannot attend traditional City-led community meetings.

Workforce

People expressed that we need to support and invest in training programs, businesses, and other supporting networks to train and hire local workers of color and to ensure that electrification jobs are inclusive, high quality, family sustaining and safe, and provide benefits.

- There is a lack of diversity in the contractor workforce to do this work. We need outreach and training to minority, women, and disadvantaged business enterprise (MWDBE) contractors to build their capacity.
- We want to be able to see someone who looks like us to invite them into our homes, and spend money on their services.
- The City needs to work with organized and unorganized labor to ensure high quality, family-sustaining jobs.

Feedback on Proposed Policies

- Historically redlined areas for a neighborhood electrification pilot could be a guide to investment. The benefits of a neighborhood approach is that it is an opportunity for community building.
- The African American community is now fragmented in Berkeley, so also consider this in the neighborhood approach that it may be more building-by-building than full neighborhoods to reach people of color.
- Consider that as home prices are high and home ownership has been restricted against people of color, time of sale does not address disparities and displacement for people of color in Berkeley.

In response to this feedback, the City developed four equity guardrails that each potential policy was assessed against. A more detailed description of the equity guardrails is included in Chapter 2.5. These guardrails were used to assess each proposed policy and will continue to be used in the future as new policies are developed.

HOW COMMUNITY FEEDBACK INFLUENCED THIS STRATEGY

Community feedback played a major role in the final policy development and proposed timeline for the electrification of Berkeley's building stock. While some of the themes such as the City taking a leading role in electrification and linking electrification to other upgrades can be and are directly addressed with additional policy development, others such as sensitivity to increased costs and gentrification/displacement risks require a more comprehensive approach to ensure the potential negative equity impacts associated with electrification policies are addressed.

2.5 EQUITY GUARDRAILS

In response to the points raised by communities and advocates, the team developed the concept of equity guardrails, which serve as the foundation of the Strategy and act as minimum standards that must be met for any proposed electrification policy to be considered. The equity guardrails are meant to distill the diverse and sometimes high level discussions about equity into a mechanism that can be used to inform policy and create concrete change. For example, originally the team anticipated developing an aggressive timeline to require electrification upgrades. However, after hearing the needs and concerns of the community, the team realized that mandatory measures were not meeting the equity guardrails of addressing cost concerns, and risk for potential displacement. The team stepped back and proposed a phased timeline, allowing time to develop resources, funding and financing programs, and education before requiring people to make these changes. Based on the feedback provided by the community and key stakeholders the following equity guardrails were developed:

EQUITY GUARDRAILS

Access to Health and Safety Benefits

Ensure marginalized communities and others most impacted by climate change equitable access to health, safety and comfort benefits from electrification like cleaner air and cooling for hot days (Chapter 1) for both homeowners and renters. Due to the upfront costs of electrification and lack of incentives for owners of multifamily buildings (see Chapter 2.0), many households will need financial support to have access to high quality upgrades and the benefits of electrification, including long-term cost savings.

Access to Economic Benefits

Ensure all community members, especially marginalized communities have equitable access to affordable funding and financing mechanisms, and to high-road job opportunities.

Maximize Ease of Installation

Ensure that incentives and programs for the community provide meaningful support to renters, owners, and marginalized community members to provide a simple process that minimizes the burdens and impacts associated with the installation of high quality electric equipment installed by a fairly paid and well trained workforce. [78]

Promote Housing Affordability & Anti-Displacement

Ensure upgrades don't displace renters or over-burden homeowners. Programs should support housing production, housing preservation, and tenant protections.

In Chapter 4.0, the process of applying the equity guardrails is further defined and each policy Chapter (Chapters 4.3–4.6) includes an equity guardrails analysis that describes the major opportunities, risks, and potential solutions that were informed by the analysis. Over time the equity guardrails should continue to be refined, updated, and implemented based on community input.

78 *For example, many rebate programs require residents to pay up-front costs and get repaid later, but this model does not work for many including low-income communities.*

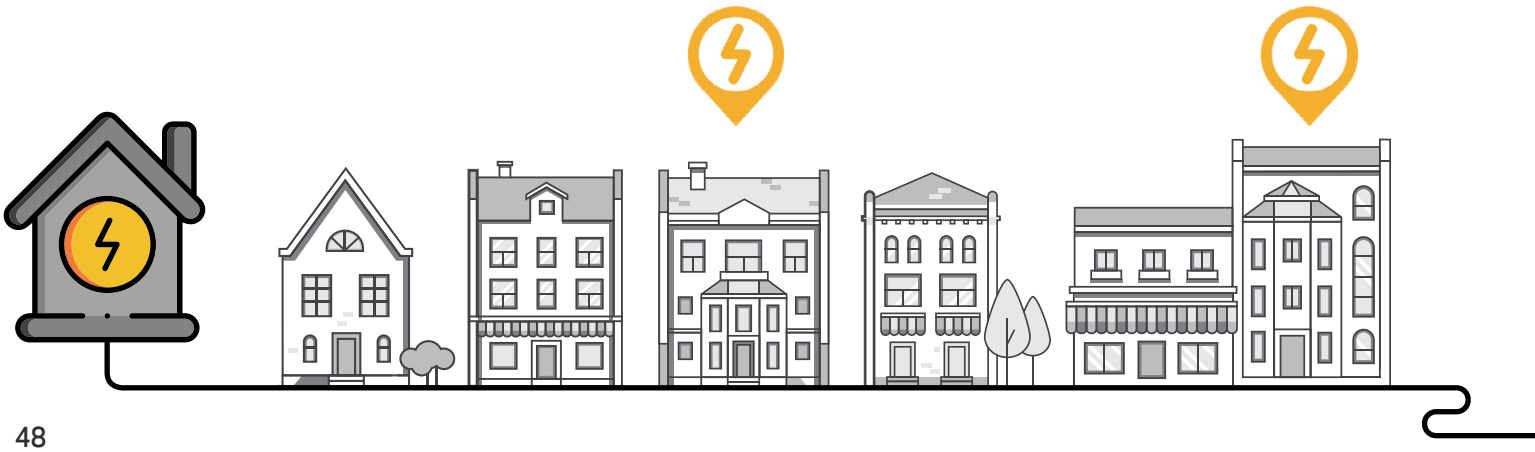
The development and implementation of the equity guardrails led to substantial changes to the Strategy. Specifically, the project team incorporated the results of the equity guardrail analysis into:

- Timeline and Phased Approach: To address the concerns of cost impacts for low- and moderate-income residents, rather than setting a goal of electrification as soon as possible (e.g. 2030) which would be very expensive under current conditions, the Strategy proposes thoughtful phasing to encourage moving forward while ensuring that sufficient structural systems (such as accessible funding and financing, education, and regulatory changes) are in place to make the transition equitable. The City also recognizes the urgent need to address the climate crisis as soon as possible, so these phases can overlap if possible.
- Specific Policy Actions: As seen in Chapter 4, the City included specific actions to address the risks identified through community feedback and the equity guardrail analysis.
- Future Education & Relationship Building: The relationships built during this process led to a successful grant application that provided funding for one of the community organizations to do additional "train-the-trainer" outreach related to building electrification. We heard that people learn best and absorb more from their peers especially around elements that include cultural shifts (such as cooking). This suggests that education efforts might be most effective if they focus on community 'nodes' who can help spread the word within their own circles.

2.6 NEXT STEPS AND RECOMMENDATIONS FOR ENGAGEMENT

The outreach and engagement for this project was conducted during the end of 2019 and throughout 2020 and consisted of both in person workshops and discussions prior to the COVID-19 shelter-in-place orders, as well as virtual conversations and workshops. This engagement coincided with the COVID-19 pandemic and social uprisings in 2020. These compounding struggles added to the economic and other resource constraints of already marginalized communities and further strained the community-based organizations that support these communities. Understanding the reality of these challenges and the collective grief and pressure on impacted communities is key in moving forward in partnership with communities as well as connecting with advocacy organizations.

This engagement process provided critical information from which the City developed an equity framework that substantially impacted the findings of the Strategy. The engagement for the Strategy starts to build a foundation for long-term discussions with the community. However, there is more to learn, and the City is committed to continuing its equity work as a fundamental part of the process by working with the community to determine the details of the programs and policies and ensure they are equitable. Electrification of Berkeley's building stock will not happen overnight, and as technologies and State policies change, the City of Berkeley and the community will need to continue to collaborate on the best approach for existing building electrification. Continued outreach might take place in the form of workshops and focus groups, individual conversations, or other methods that engage with the community. As the City continues to engage with the community, targeted universalism will be considered in order to ensure all community voices are heard. Chapter 4 outlines specific actions that have been identified to continue and expand on community engagement.



3. COST AND TECHNICAL ANALYSIS

3.1 INTRODUCTION

This chapter identifies the magnitude of resources required to transition all of Berkeley's low rise residential homes from gas to electricity by modeling upfront and long term costs and savings. The analysis quantifies the costs of electrification for homes in Berkeley given current market conditions, identifies the opportunities for cost-effective electrification under current conditions, and provides insights for policy efforts designed to quickly make building electrification cost-competitive for all Berkeley residents. While market solutions identified in this analysis are an important part of the overall electrification strategy, they do not inherently meet the goals of targeted universalism. Using an equity lens to evaluate these policies determines where the gaps are and where we need to focus public resources to ensure equity and inclusion, while simultaneously supporting market-based solutions. The magnitude of the climate crisis requires using all tools and policies necessary to eliminate the use of fossil fuels in Berkeley's buildings.

The analysis in this chapter incorporated an inventory of Berkeley's housing stock, energy, and cost models for over 35,000 Berkeley homes, and input from a technical advisory committee. Findings helped identify key opportunities for Berkeley policymakers to target today and provided other insights that informed the development of the recommended policies and the three-phase implementation approach described in Chapter 4.

3.1 MODELING ELECTRIFICATION COSTS FOR BERKELEY'S EXISTING HOMES

Methodology

This analysis began with a deep dive into Berkeley's building stock to better understand the distribution of building types and existing conditions. This analysis was followed by research into electrification measures and costs. This data was used to model different retrofit packages to identify the most cost-effective options.

Building Inventory Analysis

An analysis of the existing building stock was conducted with support from the Building Electrification Institute (BEI), which broke down buildings by square footage, building type, and vintage using Alameda County Assessor data. It's challenging to provide an exact estimating of the number of housing units in the City given limitations in parcel-level data availability— but the BEI inventory, 2017 Alameda County Tax Assessor data, and other available sources suggest a total of roughly 50,000 units within city limits. Also, although Berkeley is a primarily built-out city, additional housing units are added every year. Under current development conditions, these new units are primarily multi-family and Accessory Dwelling Units (ADUs). As of 2019, new buildings entitled in Berkeley are required to be all-electric.

The decision to focus on residential buildings was a result of this building inventory analysis, which estimated 91 percent of buildings and 65 percent of square footage are residential buildings with three stories or less (low-rise) as shown in Table 3-1.

Table 3-1. Berkeley Building Inventory by Building Type[79]

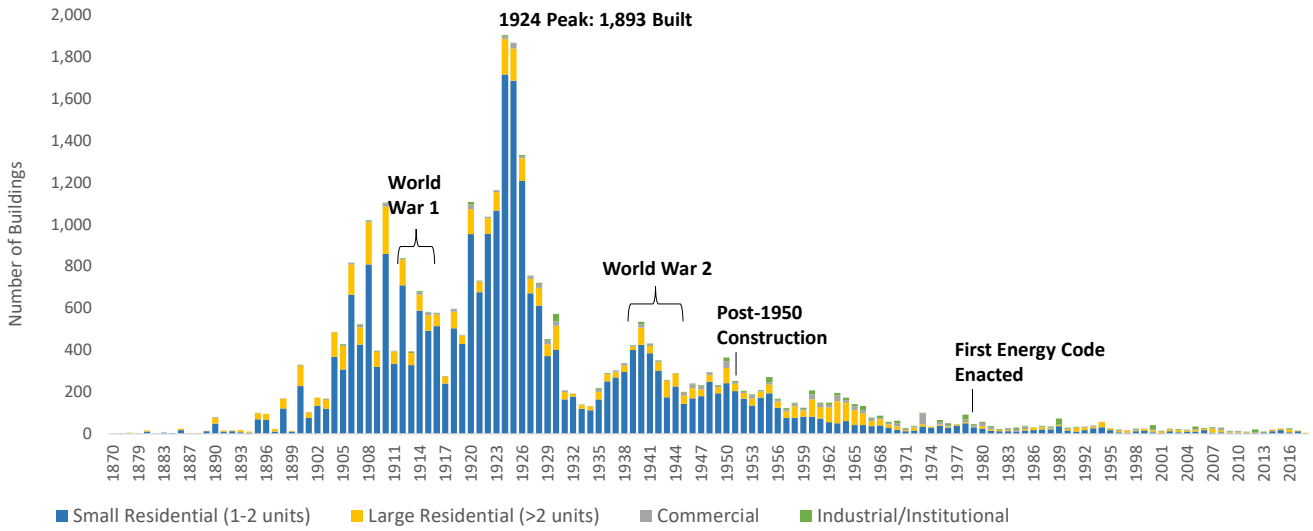
Typologies	Total Buildings	Total Square Feet	Percent of Buildings	Percent of Square Footage
Commercial, up to 3 floors	1,083	8,279,496	3.1%	9.7%
Commercial, over 3 floors	38	2,268,880	0.1%	2.6%
Industrial/institutional (excluding UCB)	1,146	10,044,605	3%	12%
Total non-residential	2,267	20,592,981	6%	24%
Single family homes	21,582	28,200,352	61%	33%
2-4 unit homes	8,259	13,681,987	23%	16%
5+ multi-family, up to 3 floors	2,476	13,620,735	7%	16%
5+ multi-family, over 3 floors	182	5,797,275	1%	7%
Total Residential	32,499	61,300,279	92%	72%
Missing Data	666	3,794,381	2%	4%
TOTAL	**35,432**	**85,687,641**	**100%**	**100%**

Berkeley buildings range in age from the City's incorporation in 1878 to present, with most homes built between 1905 to 1930 as shown in Figure 3-1. The vintage of these homes provides an indication of potential existing conditions that may influence the scope of an electrification project, including the presence of the items listed below.

- Knob and tube wiring was largely installed from 1880-1940s.
- Wall furnaces were largely installed from 1930s-1960s.
- Lath and plaster remained in use until the 1950s, when it was transitioned to drywall and plywood.
- Asbestos was a common building product until the 1970s.
- Stucco became the siding of choice in the West and Southwest, where brick and stone were too scarce and pricey to use as building materials. In seismically active California, stucco proved to be a perfect sheath.
- Vinyl Siding was introduced to the exterior market in the late 1950s as a replacement for aluminum siding.
- Sliding Glass Doors were most common in the late 1950s and 1960s.
- Aluminum Windows were most common in the1970s.

79 *Analysis conducted by the Building Electrification Institute based on multiple data sources, including 2017 Alameda County Tax Assessor data.*

Figure 3-1. Berkeley Buildings by Vintage[80]



This analysis of building vintages provided insights that many Berkeley buildings likely have the following challenging conditions to overcome during building upgrades, and there is no "one size fits all" approach:

- Poor envelope insulation/sealing
- Leaky HVAC ducts
- Lower capacity electric panels
- Knob-and-tube wiring
- Asbestos

80 *Analysis conducted by the Building Electrification Institute based on various data sources.*

ELECTRIFICATION MEASURES AND COST ASSUMPTIONS

Defining the current costs to electrify Berkeley's housing stock requires an understanding of the existing building stock, the equipment currently in use, and the range of options available for electrifying that equipment. This cost analysis focuses on low-rise (up to 3 floors) residential buildings and provides a starting point for identifying policy interventions. It should be noted that this cost analysis focuses on the financial aspects of electrification and does not include the non-monetary benefits such as health, comfort, and resilience that also need to be considered.

Electrification Equipment Measures

There are very efficient and high-performing electric appliances that can replace gas stoves, water heaters, HVACs, and clothes dryers. For example, air-source heat pumps or heat pump water heaters are three to five times more energy-efficient than their natural-gas counterparts.[81] A summary of available technologies can be found below:

- **WATER HEATING:** Heat pump water heaters (HPWHs) are highly efficient electric appliances that use electricity to move heat from surrounding air and transfers it to water in an enclosed tank, instead of generating heat directly.
- **AIR SPACE HEATING/COOLING:** Electric air source heat pumps (ASHPs) use electricity to move the heat from the air. This technology can be used to heat a building by moving heat indoors, or cool a building by moving heat outdoors, just like a refrigerator. This means ASHPs have the added benefit of providing both heating and air conditioning, while gas heating systems only provide heating. As described in Chapter 1, Berkeley will see an increase in temperature and heat waves. ASHPs can help to ensure comfort and safety during high heat days. Additionally, if the ASHP has good air filtration, this filtration can provide clean air during times with poor air quality such as wildfire smoke events.
- **COOKING:** Gas stoves and ovens can be replaced by electric ovens and induction cooktops. Residential induction cooking tops consist of an electromagnetic coil that creates a magnetic field when supplied with an electric current. When brought into this field, compatible cookware is warmed internally, transferring energy with approximately 85 percent efficiency. Furthermore, because the source of heat is the cookware itself, the cooking top surface remains cool to the touch, and less heat is lost to the surrounding air. A cooler cooking top surface also makes induction cooking tops safer to

81 *https://www.greentechmedia.com/articles/read/so-what-exactly-is-building-electrification*

work with than other types of cooking tops. Finally, because the cookware itself is the source of heat, it reaches desired temperatures more quickly and provides faster cook times. The per unit efficiency of induction cooktops is about 5-10 percent more efficient than conventional electric resistance units and about three times more efficient than gas.[82] Induction cooktops do require compatible cookware and can work with any pots and pans where a magnet clings to the bottom, which includes cast iron.

- **CLOTHES DRYERS:** Gas clothes dryers can be replaced by electric resistance or heat pump clothes dryers. A heat pump dryer works as a closed loop system by heating the air, using it to remove moisture from the clothes, and then reusing it once the moisture is removed. Rather than releasing warm, humid air through a dryer vent to the exterior of the home as a conventional dryer does, a heat pump dryer sends it through an evaporator to remove the moisture without losing too much heat. Using heat pump clothes dryers can reduce energy use by at least 28 percent compared to standard dryers and dry laundry at low temperatures, so they are gentler on clothes.[83]

The Berkeley community joined East Bay Community Energy (EBCE) in 2018, and EBCE procures the electricity for these customers. However, PG&E owns and operates the electric and gas systems that serve Berkeley homes and so PG&E still charges Berkeley residents for gas usage as well as certain fees, program charges, low-income discounts, and electric delivery rates for all electricity customers regardless of whether they are on EBCE or not. Gas is the most common fuel for space and water heating across Berkeley, with a smaller proportion of homes also using gas for cooking and/or clothes drying, as seen in the breakdown in Table 3-2. Any concerns about electronics with magnetic fields will be considered based on future regulatory studies and standards.

82 *https://www.energystar.gov/about/2021_residential_induction_cooking_tops*
83 *https://www.energystar.gov/products/heat_pump_dryer*

Table 3-2. City of Berkeley Residential Gas-Consuming Equipment Inventory

End Use	Gas System	Electric System	No System/ Other Fuel	Notes
Heating and Cooling	99%	1%	0%	5-10% of homes have central or room A/C
Hot Water Heating	92%	7%	1%	89% tanked gas, 3% tankless gas
Cooking	64%	35%	1%	Electric systems predominantly resistance
Clothes Drying	33%	63%	4%	Electric systems predominantly resistance

Other residential gas equipment including fireplaces, outdoor grills and fire pits, and spa heaters were not considered for this report. Additional details, including a comparison of building and equipment inventory estimates across a range of available sources, can be found in the Technical Appendix.

Electrification Measure Packages for Units in Low-Rise Residential Buildings

This analysis considers the upfront installation cost and life cycle impacts of nine comprehensive electrification packages with varying levels of appliance efficiency, envelope updates, and solar PV. Measure packages consist exclusively of products that are readily available in Berkeley today and were selected to represent a range of cost and performance. Packages were designed with input from local contractors, energy efficiency experts, supply-side analysts, and City staff. Table 3-3 summarizes the packages that were measured in the cost analysis for low-rise residential homes.

Modeling assumed unitary HVAC and DHW systems for all low-rise multifamily buildings; we did not consider the central systems common in larger buildings. Measure cost models were based on E3's 2019 report "Residential Building Electrification in California" and updated based on local research. See the Technical Appendix for more information on the modeling process and assumptions.

Table 3-3. Electrification Packages Modeled

#	HVAC	DHW	Clothes Dryer	Cooking Stoves	Envelope Upgrades	Solar PV	Panel Upgrades
1.1	Single-speed HP	50 gal HP	Resistance	Resistance	–	–	Y
1.2	Single-speed HP	50 gal HP	Resistance	Resistance	–	Offset	Y
1.3	Single-speed HP	50 gal HP	Resistance	Resistance	–	NZE	Y
2.1	Variable-speed HP	80 gal HP	Heat pump	Induction	–	–	Y
2.2	Variable-speed HP	80 gal HP	Heat pump	Induction	–	Offset	Y
2.3	Variable-speed HP	80 gal HP	Heat pump	Induction	–	NZE	Y
3.1	Variable-speed HP	80 gal HP	Heat pump	Induction	Y	–	Y
3.2	Variable-speed HP	80 gal HP	Heat pump	Induction	Y	Offset	Y
3.3	Variable-speed HP	80 gal HP	Heat pump	Induction	Y	NZE	Y

Definitions:

- DHW: Domestic Hot Water (Heater)
- gal = gallon
- HP = Heat Pump
- NZE = Net Zero Energy
- Single Speed HP = Central ducted heat pump that utilizes a single-stage compressor, usually lower price but less efficient than variable-speed HP
- Variable-speed HP = Central ducted heat pump that utilizes a dual-stage compressor, usually more efficient but higher cost than single speed HP

MEASURE PACKAGE 1: Package 1 electrifies Berkeley homes at the lowest possible cost. The package includes a single-speed central air source heat pump (ASHP) for heating and cooling, a 50-gallon heat pump water heater, and an electric resistance clothes dryer and stove. These lower-efficiency appliances (especially the electric resistance clothes dryer and stove) minimize upfront cost but have the potential to dramatically increase grid impacts and homeowners' utility bills.

MEASURE PACKAGE 2: Package 2 electrifies Berkeley homes with higher-efficiency equipment meant to represent a sensible balance between installed costs, operating costs, and grid impacts. The package includes a variable-speed central ASHP for heating and cooling, an 80-gallon heat pump water heater, a heat pump clothes dryer, and an induction stove.

MEASURE PACKAGE 3: Package 3 utilizes the same appliances as package 2 but also incorporates low-cost envelope efficiency improvements to reduce home air leakage (to 7 ACH50) and increase roof insulation (to R-38).

SOLAR: Each measure package developed for this report was modeled alone and with two different rooftop solar PV systems, one sized to meet the electric load of newly electrified equipment on an annual basis (referred to as "Offset PV" here) and another sized to meet the home's entire electric load including lighting, plug loads, and other existing electricity users (referred to as "Net Zero Energy PV" or "NZE PV" here).

TECHNICAL ADVISORY COMMITTEE FEEDBACK

In addition to targeted community outreach with an equity focus (discussed in Chapter 2), the project team also engaged with over 100 local technical experts, contractors, and policy experts to inform cost and energy modeling assumptions, identify the key challenges and opportunities facing community-wide electrification, and brainstormed solutions.

Technical feedback culminated with a Technical Advisory Committee workshop held in July 2020, where 70 participants provided feedback on an early draft of the analysis and policy strategies covered in this report. Some of the key feedback heard from this group included:

- The group agreed that to electrify all buildings, mandates will be required. However, there was not a consensus from the group on what mandate(s) should be required first, or when they should be required, because there are many technical and financial challenges that require further examination before mandates. The City plans to work with the community and experts to co-create these policies as part of Phases 1 and 2.
- Tariffed on-bill financing (TOBF) is a promising approach to scale electrification without creating more debt, but even with TOBF, there will be a need for public investment and other funding opportunities to support low- and moderate-income community members.
- There is a need to track and monitor equity metrics.
- There is a need to consider building envelope implications and balance between the urgency of the climate emergency and the priority of being in a comfortable and good quality home.
- There is a need to focus solutions for disadvantaged communities, particularly redlined areas, including grants for Low- and Moderate- Income (LMI) and renters.
- There is a need to better understand grid impacts including how future winter and summer peaks compare, load management, amp budgets, solar, and storage.

KEY MODELING RESULTS

The cost model results for the nine measure packages is shown in Table 3-4.

Table 3-4. Average Results for All Measure Packages

#	Electrification Package	Energy Bill Savings ($/yr)	Energy Bill Savings (%)	Gross Cost ($)	Incre-mental Cost ($)	Incremental Cost with Current Incentives ($)	Incremental Cost with Incentives + Financing ($)
1.1	Economy Appliances	-$540	-33%	$19,870	$7,930	$7,930	$12,290
1.2	Economy Appliances + Offset Solar	$540	33%	$26,160	$14,220	$14,220	$5,610
1.3	Economy Appliances + NZE Solar	$1,480	89%	$32,270	$20,330	$20,330	$1,470
2.1	Mid-Tier Appliances	$5	0%	$24,750	$12,110	$9,910	$9,880
2.2	Mid-Tier Appliances + Offset Solar	$590	35%	$28,200	$15,560	$13,360	$6,090
2.3	Mid-Tier Appliances + NZE Solar	$1,510	91%	$34,270	$21,630	$19,430	$1,700
3.1	Mid-Tier Appliances + Envelope	$90	5%	$29,320	$16,690	$13,240	$12,540
3.2	Mid-Tier Appliances + Envelope + Offset Solar	$600	36%	$32,350	$19,720	$16,720	$9,470
3.3	Mid-Tier Appliances + Envelope + NZE Solar	$1,510	91%	$38,410	$25,780	$22,320	$4,520

Note: Modeled costs are averages and electrification costs may be higher or lower depending on individual building characteristics

Definitions:

- **Energy bill savings:** The net change in year-one utility bills after installing all-electric appliances.
- **Gross cost:** The cost a Berkeley homeowner sees for installing all-electric appliances. This reflects the material, labor, and overhead costs quoted by a local contractor for installation but not existing/future incentives.
- **Incremental cost:** The incremental cost of installing all-electric appliances over the cost of installing new gas appliances ($0 would reflect cost parity with gas appliance options).
- **Incremental cost with current incentives:** This line incorporates 2021 incentive offerings from BayREN for specified all-electric appliances and envelope upgrades.
- **Incremental cost with incentives + financing:** The incremental cost a homeowner would pay up-front if financing their all-electric upgrade through a tariffed on-bill financing program (terms detailed in section 3.3).

Any one of these nine packages can achieve a net zero emissions target under EBCE's zero-carbon "Brilliant 100" rate tariff, which is accessible to Berkeley residents and roughly matches the PG&E E-1 tariffed modeled for this report.[84] Electrifying gas appliances would save Berkeley 2.5 tons of CO_2 emissions per home every year.

Several future developments should continue to improve the economics of electrifying Berkeley's housing:

- **INSTALLED COSTS:** Installed heat pump and solar PV costs are expected to drop roughly 10 percent between 2020 and 2030.[85] Targeted training programs could result in even more significant cost reductions in Berkeley's labor market.
- **UTILITY RATES:** Gas rates are projected to increase 22 percent between 2020 and 2030.[86]
- **ELECTRIC TARIFF OPTIMIZATION:** Time-of-use rates, which are quickly becoming the standard in California, could improve the value proposition for electric appliances with smart load shifting controls.[87] Other rate tariff innovations could be designed to support electrification.
- **CLIMATE CHANGE:** Warmer summers increase the need for (and value of) high-efficiency cooling in Berkeley, where A/C ownership is expected to double between 2020 and 2050 (see Section 3.2).

Berkeley cannot mandate building electrification for all residents today without negatively impacting housing affordability and energy security for its residents. But this market is rapidly evolving. The value proposition will only continue to improve, and there are other non-monetary benefits to consider. The remainder of this chapter identifies immediate opportunities to catalyze the building electrification transition and analytical insights to inform policies intended to bridge the gap between current market conditions and cost parity for all Berkeley residents.

84 *https://www.pge.com/pge_global/common/pdfs/customer-service/other-services/alternative-energy-providers/community-choice-aggregation/ebce_rateclasscomparison.pdf*

85 *https://www.nrel.gov/docs/fy18osti/70485.pdf; Kristen Ardani, Jeffrey Cook, Ran Fu, and Robert Margolis, Cost-Reduction Roadmap for Residential Solar Photovoltaics (PV), 2017–2030 (National Renewable Energy Laboratory, January 2018).*

86 *Energy+Environmental Economics, Residential Building Electrification in California (2019). Assumptions calibrated with current PG&E residential gas rate projections for 2020: https://www.pge.com/tariffs/Residential.pdf*

87 *An RMI analysis of PG&E's default time of use rates in 2017 found only a 3% savings on annual electricity costs from these load-shifting controls. However, homeowners on opt-in rates with a large spread between peak and off-peak pricing saw a 21% cost savings. Rocky Mountain Institute, Economics of Electrifying Buildings (2018).*

THE EXTREME COST OF DOING NOTHING

Building electrification is a relative bargain compared to the cost of alternative pathways for achieving building sector climate goals. While the upfront costs of electrifying Berkeley's existing buildings may exceed status quo fossil fuel replacements under current market conditions, it is crucial to put those costs in the context of the substantial costs from inaction or delayed action. Appliance electrification is the lowest-cost, least-risk pathway to decarbonize the building sector, especially when considering the avoided societal impacts of pollution and climate effects.[88]

In California, buildings are now the leading cause of premature death from combustion emissions.[89] Most of these emissions come from using fossil fuel appliances, which release pollutants like carbon monoxide, formaldehyde, and nitrogen oxides (NO_x) – a pollutant that creates smog and fine particulate matter (PM2.5). These pollutants degrade our air and harm our health. Children and lower-income households have a higher risk of health impacts from gas appliance pollution, such as increased risk of asthma and respiratory illnesses.[90]

Research makes clear that using electric appliances can greatly reduce our exposure to toxic pollution. Children living in a home with a gas stove have a 42 percent higher risk of experiencing asthma symptoms and a 24 percent higher risk of being diagnosed with asthma by a doctor, compared to children living with electric stoves.[91] UCLA researchers estimate that if we electrify all of the fossil fuel appliances in the Bay Area, we could avoid over 300 respiratory illnesses, save over 130 lives, and save $1.2 billion in healthcare costs — every year.[92] Electrification is essential for our residents' health and well-being.

88 *https://rmi.org/building-electrification-a-key-to-a-safe-climate-future/#:~:text=In%20order%20to%20achieve%20the,residential%20buildings%20is%20to%20electrify*

89 *Irene C. Dedoussi, et al., Premature mortality related to United States cross-state air pollution, 578 NATURE 264 (2020), available at https://doi.org/10.1038/s41586-020-1983-8.*

90 *Brady Seals and Andee Krasner, Health Effects from Gas Stove Pollution, RMI, Physicians for Social Responsibility, Mothers Out Front, and Sierra Club (2020), available at https://rmi.org/insight/gas-stoves-pollution-health/*

91 *Weiwei Lin et al., Meta-Analysis of the Effects of Indoor Nitrogen Dioxide and Gas Cooking on Asthma and Wheeze in Children, 42 International Journal of Epidemiology 1724 (2013), available at https://doi.org/10.1093/ije/dyt150.*

92 *UCLA Fielding School of Public Health, Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California (2020), Appendix B, Tables B-3 and B-4, available at https://coeh.ph.ucla.edu/effects-of-residential-gas-appliances-on-indoor-and-outdoor-air-quality-and-public-health-in-california/.*

Electrification is also much less costly compared to alternative pathways to building decarbonization that rely on renewable gas. In California, a renewable gas approach will cost four times as much as an electrification approach.[93] For consumers, E3 estimates that an electric heat pump "would cost $35 to $53 per month to operate, while renewable gas (RNG) in a gas furnace would cost $160 to $263 per month to operate."[94] The addition of new electric loads from electrification can also help with rate affordability and may even reduce energy bills.[95]

From a systems perspective, electrification reduces the cost and risk of investing money in gas infrastructure that may ultimately need to retire soon. The State spends nearly $3.5 billion a year to maintain the existing gas system.[96] Berkeley's ordinance requiring all-electric new construction helps avoid investing in new gas infrastructure, but electrification of existing homes can help evade the need to invest in existing pipeline maintenance and potentially support targeted pipeline retirement. This also demonstrates the value in electrifying sooner rather than waiting. The longer we wait to electrify the building stock, the more money we will have spent in a waning gas system.

By transitioning our buildings from fossil fuels to electric appliances, we achieve the benefits of improving health and air quality, avoiding health and safety risks of gas, addressing climate change, and reducing investments in expensive gas infrastructure.

93 *https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf Page 4*

94 *https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf Page 39*

95 *https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2021/senate-bill-695-report-2021-and-en-banc-whitepaper_final_04302021.pdf Page 8*
https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf Page 5

96 *https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf Page 60*

3.2 OPPORTUNITIES TO TARGET TODAY

The financial modeling found that many homes in Berkeley can be cost-effectively electrified today without new financing programs, next-generation technologies, or other policy interventions. These buildings, which are predominantly single-family homes occupied by more affluent community members, are not a priority from a targeted universalism perspective—but they represent essential opportunities to capture in Phase 1 policies for market development. Capturing the trigger points that support or enable cost-effective building electrification today allows the City of Berkeley to demonstrate success, build local distributor and installer capacity, and learn best practices for future policy before broad mandates are enacted.

Any incentive (financial or other) provided for these short-term market-based efforts should be considered and balanced with resourcing for long-term, more inclusive tactics that are accessible to all buildings to achieve a full transition from gas in the residential sector.

HOMEOWNERS INSTALLING SOLAR, BATTERIES, OR ELECTRIC VEHICLE CHARGERS

Rooftop solar PV has an extremely beneficial impact on the project economics for building electrification in Berkeley. Without solar, some Berkeley homeowners are seeing a utility bill increase after converting to heat pump equipment (depending on the equipment efficiency specified and expected use) due to the electric rates offered through PG&E and EBCE, which are currently 80 percent higher than the national average.[97] Solar PV is a comparatively low-cost source of electricity, yielding a typical levelized cost of energy (LCOE) of $0.13/kWh in Berkeley—roughly half the rate of grid-supplied electricity.[98] This lower cost of electricity has an enormous impact on the economics of electrification in Berkeley.

Google's Project Sunroof estimates that most homes in Berkeley are good candidates for a solar PV system:[99]

- 88 percent of rooftops are considered "solar viable."[100]
- 69 percent of all rooftops can support a 5+ kW solar system.
- 58 percent of all roofs are flat or south-facing.
- Solar-viable rooftops produce an average of 1410 kWh/year per kW-DC installed.

The current value proposition for solar suggests that Berkeley can lean on homeowners already considering rooftop solar installations to lead the first phase of the building electrification transition. This is especially true of homeowners installing larger solar systems that rely on a net energy metering (NEM) policy that has, to date, disproportionately benefited higher-income ratepayers (discussed in Section 3.3). These projects can serve as a trigger for less cost-effective electrification or electric readiness requirements—for example, Berkeley could require that these homeowners couple installations with the wiring and panel, battery storage, or heat pump water heaters upgrades to facilitate full electrification in the future. Requiring electric appliance upgrades with solar PV installations provides the synergistic benefit of increasing a home's electric load and allowing homeowners to purchase even larger solar systems without utilizing NEM.

97 *https://www.next10.org/sites/default/files/2021-02/Next10-electricity-rates-v2.pdf*

98 *Calculated via https://www.nrel.gov/analysis/tech-lcoe.html with a $3.35/W installed cost, 26% ITC savings, and otherwise default assumptions.*

99 *https://www.google.com/get/sunroof/data-explorer/place/ChIJ00mFOjZ5hYARk-I1ppUV6pQ/*

100 *Solar-viable: Any rooftop where an installation would reach at least 75% of the efficiency of an optimally oriented and unshaded system.*

Other distributed energy resource (DER) projects, including battery energy storage systems and electric vehicle charging stations, provide a similar opportunity for electric-readiness requirements. Battery energy storage systems are particularly advantageous because of the synergistic benefit these products have with solar PV: batteries can allow homeowners to specify larger PV systems (and save more on their utility bills) without relying on NEM policies. Homeowners who value the resilience benefits of battery storage can enable fully off-grid (and zero carbon) operation by electrifying their gas appliances. Additionally, stakeholder engagement in Berkeley has identified increasing community interest for backup power in the face of recent Public Safety Power Shutoff events.

Berkeley will need to re-evaluate the design of any DER-triggered requirements once the NEM 3.0 tariff is finalized. The City must also balance the synergistic benefit of DER-based electrification requirements with the need to provide more equitable access to the economic benefits of these technologies, which to date have been disproportionately utilized by higher-income constituents in owner-occupied homes.

HOMEOWNERS REPLACING OR INSTALLING AIR CONDITIONING

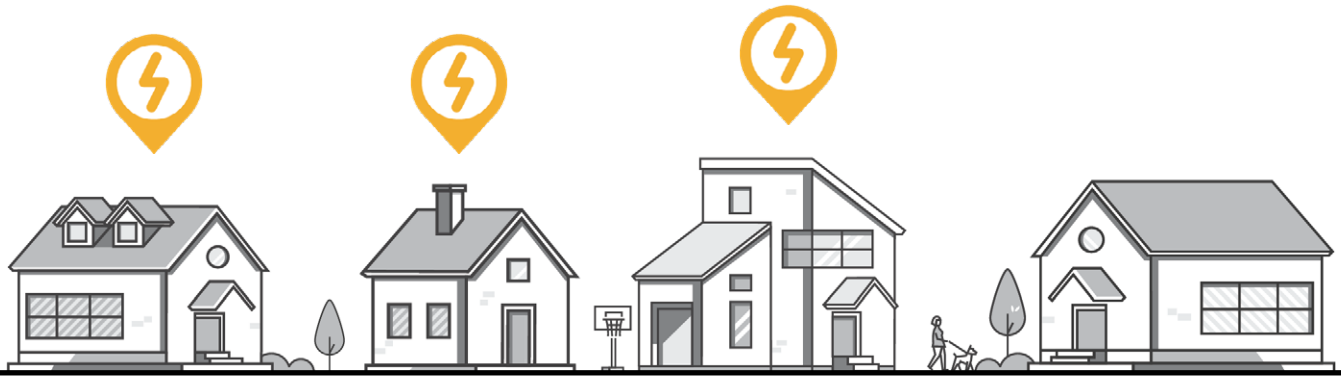
Homeowners replacing or installing new air conditioning systems present an essential opportunity for cost-effective building electrification. Because heat pump upgrades provide both heating and cooling benefits, they can replace both a furnace and an air conditioner. The average whole-house air conditioning system installation costs $9,500 in Berkeley,[101] meaning that a heat pump system can be less expensive than installing a new central furnace and air conditioner alone. Air conditioner installations and replacements can be a particularly advantageous trigger for a heat pump upgrade for two reasons:

- **MORE AFFORDABLE:** Air conditioning installations can be more expensive than furnace replacements, meaning homeowners pay a smaller incremental cost for the heat pump upgrade. Whole house air conditioning is also currently considered a luxury in Berkeley's climate, suggesting that these homeowners may be more able to afford a cost increase for higher-performance products.
- **EASIER INSTALLATION:** Whereas converting a gas furnace to heat pump represents a new electrical power load, homes with older whole-house air conditioners can sometimes reduce their overall power draw with a heat pump conversion. This conversion can protect homeowners from the added cost and time of upgrading their electrical panel.

The incremental cost of replacing a whole-house air conditioning system with a heat pump depends on the assumed value of the heating and cooling systems being replaced. If both the existing gas furnace and air conditioner need to be replaced, both the economy-tier and mid-tier ASHPs modeled for this report can be installed at an upfront cost savings. A mid-tier heat pump upgrade upon A/C failure could save homeowners money on installation if the furnace has less than 4 years of remaining useful life, while an economy heat pump product can save the money if the furnace has less than 12 years of remaining life.[102]

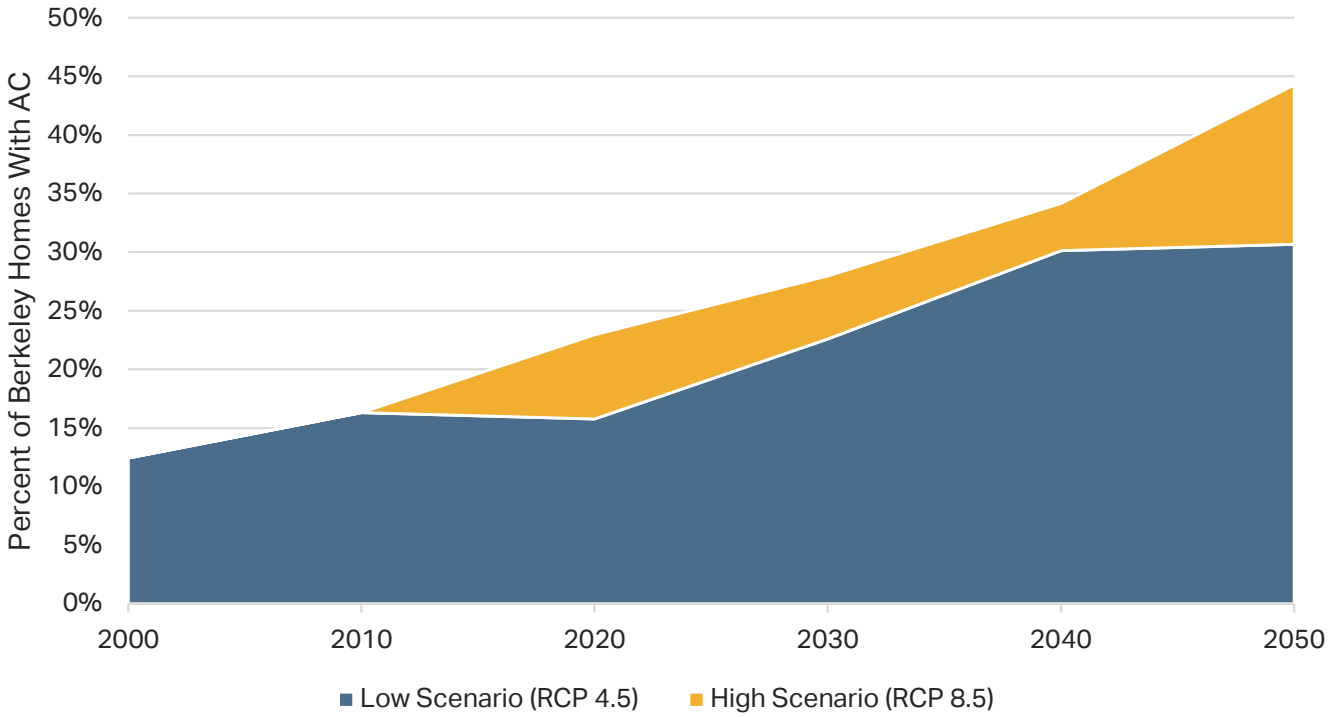
101 Assumes a whole-house air conditioner with two ton (i.e. 24 MBH) capacity per home.

102 These numbers assume a 40 MBH gas furnace, 2 ton A/C system, and 3.5 ton heat pump system, with the furnace's value depreciating linearly with age.



Fewer than 10 percent of Berkeley homes currently utilize whole-house air conditioning. But as the climate warms, air conditioning systems will become substantially more popular in the Bay Area and will provide greater climate resiliency. Climate models suggest that cooling degree days in Berkeley will increase 53-72 percent by 2050, resulting in up to 44 percent A/C ownership as shown in Figure 3-2.[103]

Figure 3-2. Projected A/C Ownership in Berkeley Over Time



These projections suggest that over 6,000 existing homes will purchase new air conditioning systems by 2045. Capturing these installations can reduce summer grid peak load, minimizing supply-side costs that contribute to electricity rate increases for all homeowners. Berkeley should work with A/C installers and heat pump manufacturers to ensure these homes install heat pump systems instead.

103 *Climate modeling via Cal-Adapt, https://cal-adapt.org/tools/degree-days/#climatevar=cdd&scenario=rcp45&lat=37.28125&lng=-120.46875&boundary=locagrid&thresh=65&units=fahrenheit. Correlation to A/C ownership rates defined by Sailor et al, 2003 (https://doi.org/10.1016/S0360-5442(03)00033-1). See Figure 1(a).*

HOMEOWNERS PURCHASING OR REFINANCING HOMES

Modeling found that over 50 percent of homeowners could see positive cash flows from day one by financing the incremental cost of electrification package 2.2 (mid-tier appliances with offset solar PV) over a 4 percent APR, 30-year term with just a $1,000 increase over existing incentives, while virtually all homeowners could cost-effectively finance packages with larger solar systems. These terms are available to both homebuyers and refinancers through green mortgage products like Freddie Mac's GreenCHOICE® and Green Advantage® mortgage products. These products present concerns about financing terms that exceed the expected life of new building equipment—but forward-thinking homeowners may be willing to take on that risk and use these long-term products to cover the added one-time cost of fuel switching if they expect heat pump products to reach cost parity with gas alternatives in the foreseeable future.

Green mortgage products are underutilized today and cannot currently be applied to all building electrification measures, but major lenders including Freddie Mac and Fannie Mae are actively developing pilot programs and recommendations to increase their reach as part of their efforts under the Federal Housing Finance Agency's Duty to Serve Program. The maximum qualifying loan for loans eligible products is currently $822,375 and the median home sale price in 2021 is $1.5 million according to Realtor.com. The City of Berkeley is collaborating with efforts by the Department of Energy to expand eligibility for these loans and will need to work directly with local lenders to determine when and how to expand access to these products in Berkeley.

POINT OF REPLACEMENT FOR EXISTING EQUIPMENT

Berkeley should work to ensure that most of its homeowners are able to electrify existing buildings as old gas equipment fails, rather than incentivizing or requiring them to bundle all appliance upgrades into a single project. Project bundling can minimize the cost and complexity of performing multiple equipment replacements, but this benefit is counterbalanced by the lost value embodied in gas equipment that is replaced before failure. Berkeley can reduce the necessary incentive for cost-competitive electrification and mitigate backlash to electrification requirements by targeting situations where homeowners already need to pay for equipment replacement. When Berkeley homeowners pay the amount that they would otherwise have to pay for gas equipment, they typically cover 50-60 percent of the cost for electrification (not including costs for solar PV). Berkeley could also elect to incorporate upgrade requirements for lower-cost appliances (namely the dryer and/or cookstove) at the time a home's furnace, which represents at least 44 percent of the total value of a home's existing gas equipment, once sufficient incentives are in place to cover the lost value of any early-retired equipment.

Relying on point-of-replacement policies for building electrification in Berkeley does bring its own challenges:

Electrical Capacity Concerns

Berkeley needs to ensure that homeowners have sufficient electric panel capacity and available circuitry for appliance fuel switching projects. These upgrades, which are necessary in over 80 percent of Berkeley's aging housing stock with current technology, can take weeks or even months to complete under current permitting processes and wait times.

Berkeley could help homeowners avoid this engineering challenge by incorporating electrical upgrade requirements into the previously-mentioned trigger points for near-term electrification requirements: distributed energy resource projects, air conditioning installations, and home sale/refinancing. Berkeley could also focus initial efforts on a community-wide panel upgrade adoption campaign. But the upgrades are costly (potentially over half the incremental cost of electrifying a Berkeley home[104]), and the supply-side impacts of dramatically increasing each home's electrical capacity, which force transmission and distribution upgrades and increase operating costs, are significant.

104 *Our models assumed up to $1,150 per home for wiring upgrades and $3,000 per home for panel upgrades, and many Berkeley residents have reported higher costs in the current labor market. This cost makes up over 50% of the incremental cost for electrification under measure package 1.1.*

Electrical upgrade costs can be minimized or avoided altogether with innovative products and design principles including:

- Newer heat pump products capable of operating on 120 Volt, 15 Amp wiring circuits (commonly already available in existing homes). Note that these products will not necessarily mitigate new wiring costs in homes with knob-and-tube wiring, which may be unsafe to utilize.
- Smart load management solutions that allow homeowners to balance loads on their existing electrical panel (e.g., by only charging their EV when other appliances are turned off)
- Attributing some or all of the panel upgrade cost to other decarbonization technologies likely to become mainstream in Berkeley by 2045 (including solar PV, batteries, and EV charging)

Project Financing Challenges

A focus on point-of-replacement policies suggests that Berkeley homeowners could require financing for several different electrification projects. Financing entities need to find a reasonable way to support these separate projects rather than a single bundled effort. This issue is complicated by the fact that some electrification measures (namely clothes dryer and cookstove electrification) currently yield zero or negative operating cost impacts.[105]

105 *https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf*

3.3 OTHER INSIGHTS FOR POLICY DEVELOPMENT

Energy and cost modeling analysis yielded a range of other insights that can inform goal setting and policy development in Berkeley:

ACCESSIBLE FINANCING SOLUTIONS ARE ESSENTIAL

Berkeley residents can use financing programs to cover a significant portion of the added upfront cost for electrifying their homes. An example of a type of financing program which, if developed in an accessible and affordable way can help to scale building electrification, is tariffed on-bill financing (TOBF). In a TOBF program, upgrades (such as electrification and/or efficiency upgrades) are financed not through a loan, but through a utility offer that pays for upgrades under the terms of a new, additional tariff. This tariff includes a cost recovery charge on the bill that is less than the estimated savings. The on-bill charge is associated with the meter at the address of the property or facility where upgrades are installed, and the cost recovery charge is treated as equal to other utility charges on the bill.[106] A tariffed investment does not add to the debt profile of the location owner the way a bank loan would. A benefit of this model is that it can be utilized by renters and LMI customers, especially those with limited credit or low credit scores, because the utility's investment is based on the cost effectiveness of the upgrades and not the socio-economic status of the bill payer at that location.[107] Furthermore, because the investment is at the meter, the investment and payback stay at the property and do not follow the resident if they decide to move.

The amount amortized in Table 3-4 reflects cash flow estimates utilizing the Pay As You Save®[108] tariffed on-bill financing (TOBF) model[109]. This financing vehicle treats the utility as a bank and spreads the cost of a home's energy upgrades over years of utility bills, with occupants guaranteed not to pay

106 *https://www.aceee.org/toolkit/2020/02/bill-energy-efficiency#:~:text=Tariffed%20on%2Dbill%20(TOB),less%20than%20the%20estimated%20savings.*

107 *https://mk0southeastene72d7w.kinstacdn.com/wp-content/uploads/SEEA_TOBGuide_FINAL_UPDATED_2020_04_13.pdf*

108 *Pay as You Save® (PAYS®) is a market-based system developed by the Energy Efficiency Institute (EEI) that provides a platform for TOB investment programs. PAYS is the most widely used form of tariffed on-bill programs for energy efficiency. https://mk0southeastene72d7w.kinstacdn.com/wp-content/uploads/SEEA_TOBGuide_FINAL_UPDATED_2020_04_13.pdf*

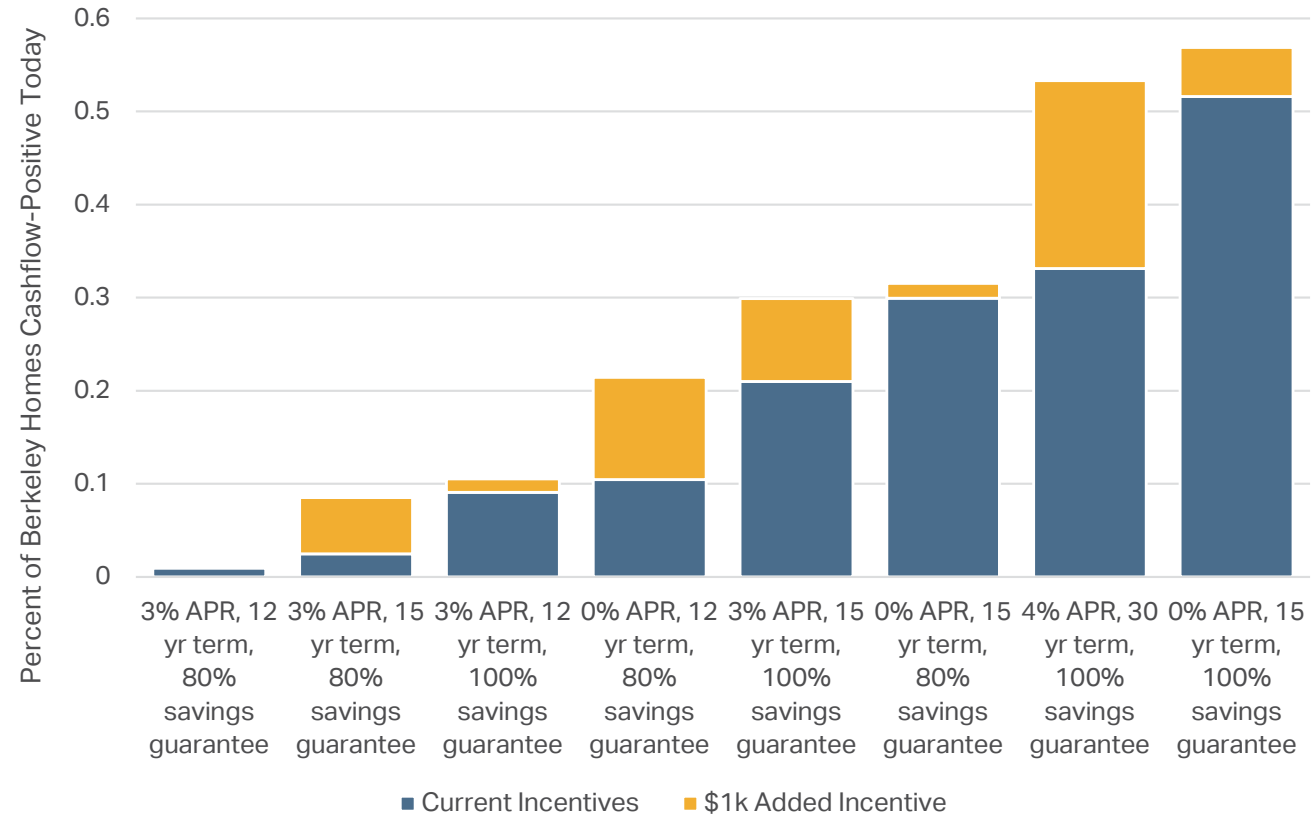
109 *See Building Decarbonization Coalition's 2020 report Towards an Accessible Financing Solution*

more than they save on their energy costs. TOBF was modeled in this report with the following terms:

- Rate: 3.0 percent APR
- Term: 20 years for solar PV, 12 years for other measures
- Monthly financing payment capped at 80 percent of modeled energy savings

These terms buy down the cost of all modeled electrification + solar packages by at least 40 percent. More aggressive financing terms can cover even more of that cost and present opportunities for cost-effective building electrification even under today's conditions as shown in Figure 3-3.

Figure 3-3. Impact of Different Financing Terms on Package 2.2 (Mid-Tier Appliances With Offset Solar)



As the most essential driver of cost parity identified in this report, the City of Berkeley must ensure that all residents have access to competitive financing terms to ensure equitable access to the building electrification transition. TOBF programs can meet this requirement by providing a solution that can:

- Finance over long (10+ year) terms
- Address the tenant-owner split incentive in rental properties
- Provide access to residents with lower credit scores and/or irregular income
- Stay tied to location upon sale or ownership transfer
- Provide financial guarantees to participants
- Avoid additional points of contact

There is not currently a TOBF program in California that could be used for building electrification in Berkeley, but establishing one is essential to reducing the cost and time necessary to decarbonize Berkeley's housing stock. The CPUC, PG&E, and other partners must move to implement a TOBF program (or a similarly accessible financing solution) for Berkeley to follow through on commitments to local, State, and national building decarbonization goals. The CPUC's Clean Energy Financing rule making provide one immediate opportunity to advocate for this solution.

Existing financing programs, including Home Energy Line of Credit (HELOC) loans and green mortgage products, present opportunities for Berkeley residents currently pursuing voluntary fuel switching projects. Local community banks and credit unions may provide other options.

Financing programs need to be paired with other financial incentives for Berkeley residents to electrify cost-effectively. Chapter 4 of this report details potential funding sources and programs aimed at reducing the cost of fuel-switching projects.

ROOFTOP SOLAR PV CONSIDERATIONS

California adopted net energy metering (NEM) policies in 1995 to encourage customers to install renewable energy resources, with SB 656 requiring utilities to compensate customers for renewables such as rooftop solar (also known as behind the meter resources). Under current "NEM 2.0" rules, customers are paid for the electricity generated by their solar panels at the utility's retail rate and get equal credit for any excess generation

on their bills. These rules have accelerated the installation of rooftop solar PV systems across California, with customer-owned renewables now making up 11 percent of the State's total electricity production capacity (80 GW). But while NEM has been a vital tool for achieving state-grid decarbonization goals, it has also disproportionately benefited the residents who can most easily access those systems[110]: the California Public Utilities Commission (CPUC)'s 2021 NEM 2.0 Lookback Study found that "NEM 2.0 participants benefit from the structure, while ratepayers see increased rates."[111] The CPUC and the state's Independent Emissions Market Advisory Committee both estimate that under the current NEM 2.0 policy, the lowest-income Californians (who are least likely to benefit from NEM) could save $80 to $100 per year if the cost of current NEM policies were not included in their bills.[112] The value proposition for rooftop solar PV systems needs to change substantially to correct this disparity in outcomes.[113]

As Berkeley seeks to elevate measures that support targeted universalism and community-wide solutions, rooftop solar presents a multifaceted strategic planning challenge: Under NEM 2.0 guidelines and electric rates, larger rooftop solar systems can dramatically improve project economics and make building electrification a cost-neutral investment for over one-third of Berkeley's homes—but at the expense of contributing to increased rates for those left behind across PG&E's service territory. Given this challenge and the impending impact of NEM 3.0, which is expected to diminish the value of solar system overproduction, Berkeley cannot rely on the economics of electrification projects with oversized solar systems to validate policy mandates. The value proposition for those larger systems is also expected to be diminished with the adoption of NEM 3.0 sometime in 2022, which could in turn improve the value of residential battery systems and load-balancing technologies.

Berkeley should only consider the modeled cash flows of electrification packages with smaller PV systems that rarely overproduce (measures 1.2, 2.2, and 3.2 in this report) in defining a long-term approach to building electrification that centers equity. Solar-focused programming must also provide equitable alternatives for residents without easy access to rooftop solar systems. East Bay Community Energy, which currently provides 100 percent renewable electricity rate tariffs for a small premium and is committed to utility-scale and local community-scale renewable development, could provide alternatives.

110 *Lawrence Berkeley Labs found that around half of the state's solar adopters are in the highest 20 percent of earners, while only 4 percent come from the lowest 20 percent. See https://emp.lbl.gov/solar-demographics-tool*

111 *https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/en-banc/informal-public-comments/pge_white-paper_comments.pdf*

112 *https://energyathaas.files.wordpress.com/2021/03/n10_ie-charts-f5_0.png, https://calepa.ca.gov/independent-emissions-market-advisory-committee/*

113 *Rooftop Solar in California is Ready to Take the Next Step, Chhabra, Mohit and De Lamare, Julie, NRDC, CleanTechnica, March 17, 2021.*

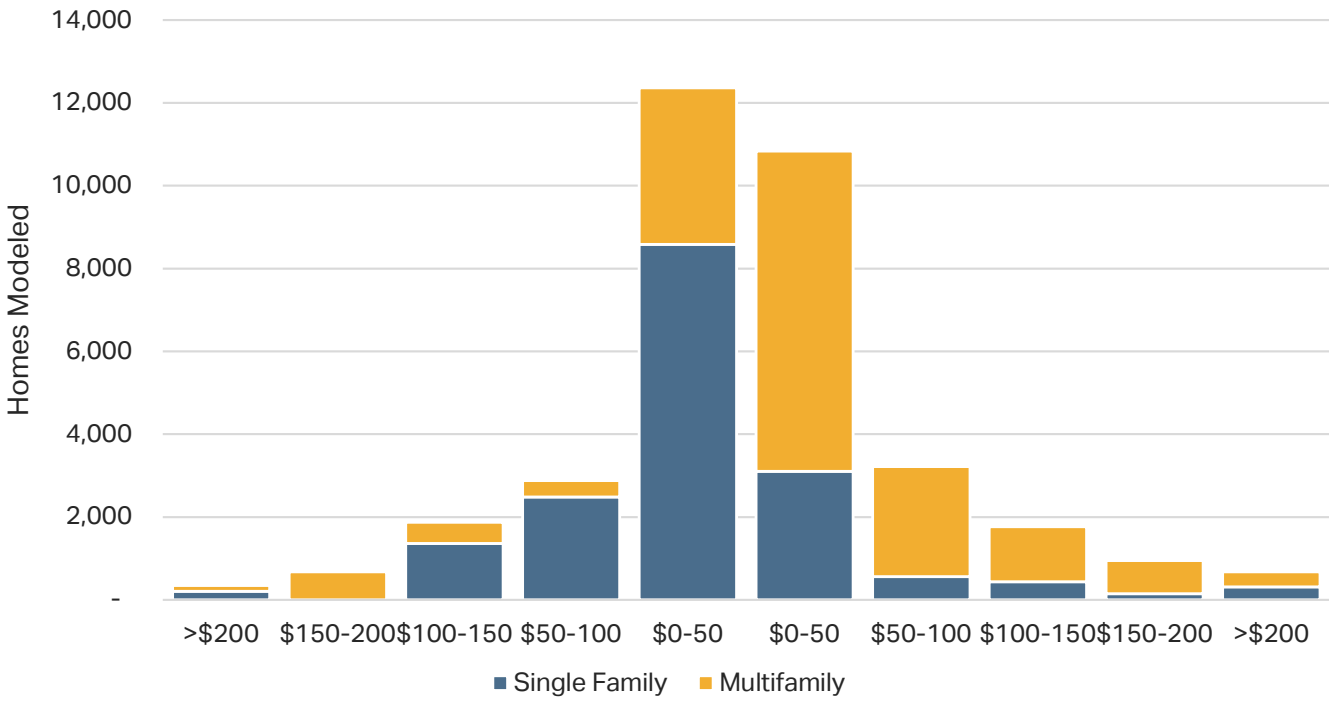
INVEST IN APPLIANCE EFFICIENCY

The City of Berkeley needs to ensure that building electrification does not result in higher utility bills to meet its equity guardrails and promote scaling. Modeling results suggest that economy-tier (and less efficient) products like the electric resistance cooktop, electric resistance clothes dryer, and single-speed ASHP modeled in package 1.1 can increase annual energy bills by 10-42 percent.[114]

Investing in the higher-performance appliances modeled in measure package 2.1, on the other hand, brings the utility bill for an all-electric household to cost parity with typical dual-fuel homes: 49 percent of Berkeley households saw lower annual utility bills in our modeling, with 86 percent of households seeing bills change by less than 5 percent. The modeled annual energy savings is shown in Figure 3-4.

Impacts vary between Berkeley's single-family buildings ($10/year average bill savings) and multi-family units ($20/year average bill increase). Because multifamily homeowners encounter more hurdles to incorporating solar PV in their home retrofits, this suggests that income-qualified assistance programs like PG&E's CARE and FERA programs remain an essential part of the solution.[115]

Figure 3-4. Modeled Annual Savings for Measure 2.1

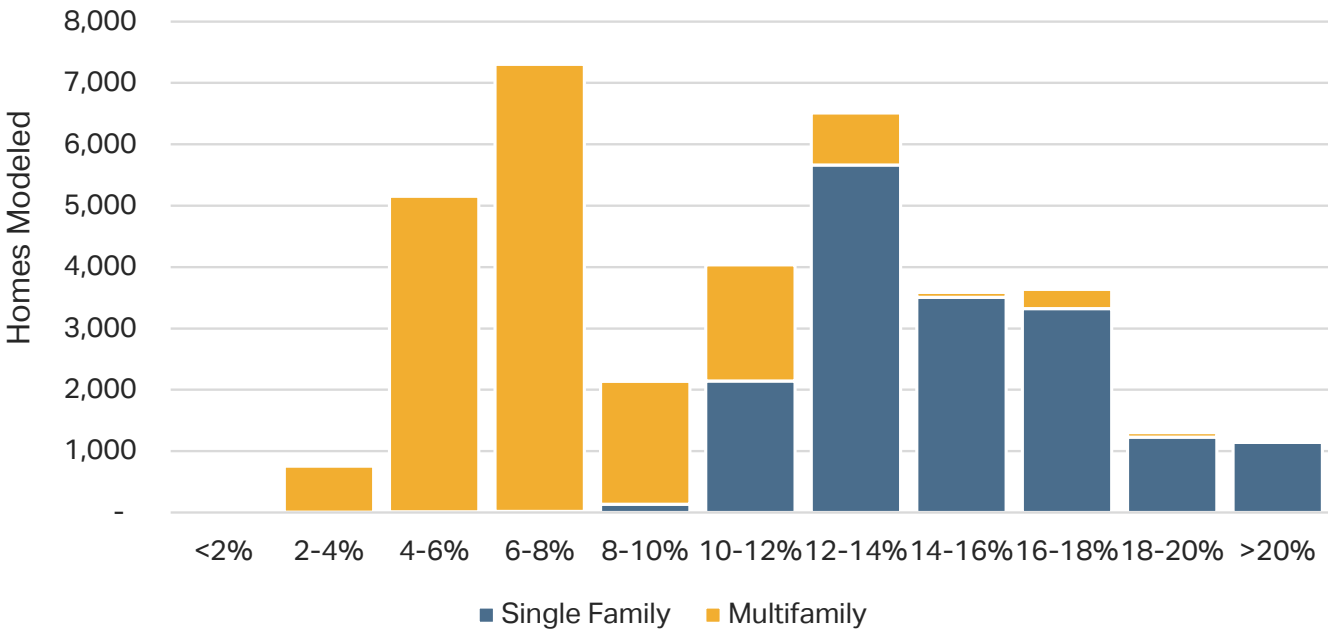


114 *10th and 90th percentile values from modeling.*

115 *The CARE program as currently designed does not incentivize building electrification because it reduces both gas and electric bills uniformly.*

Purchasing mid-tier electric appliances over economy-tier electric units represented an average incremental cost of $4,880 per home in the modeling performed for this report. But that investment paid off over time, yielding a simple return-on-investment (ROI) of 12 percent and reducing the upfront incentive needed for cash flow-neutral financing by over $2,400 per home as shown in Figure 3-5.

Figure 3-5. ROI for Added Investment in Higher-Efficiency Appliances in Berkeley's Housing Stock



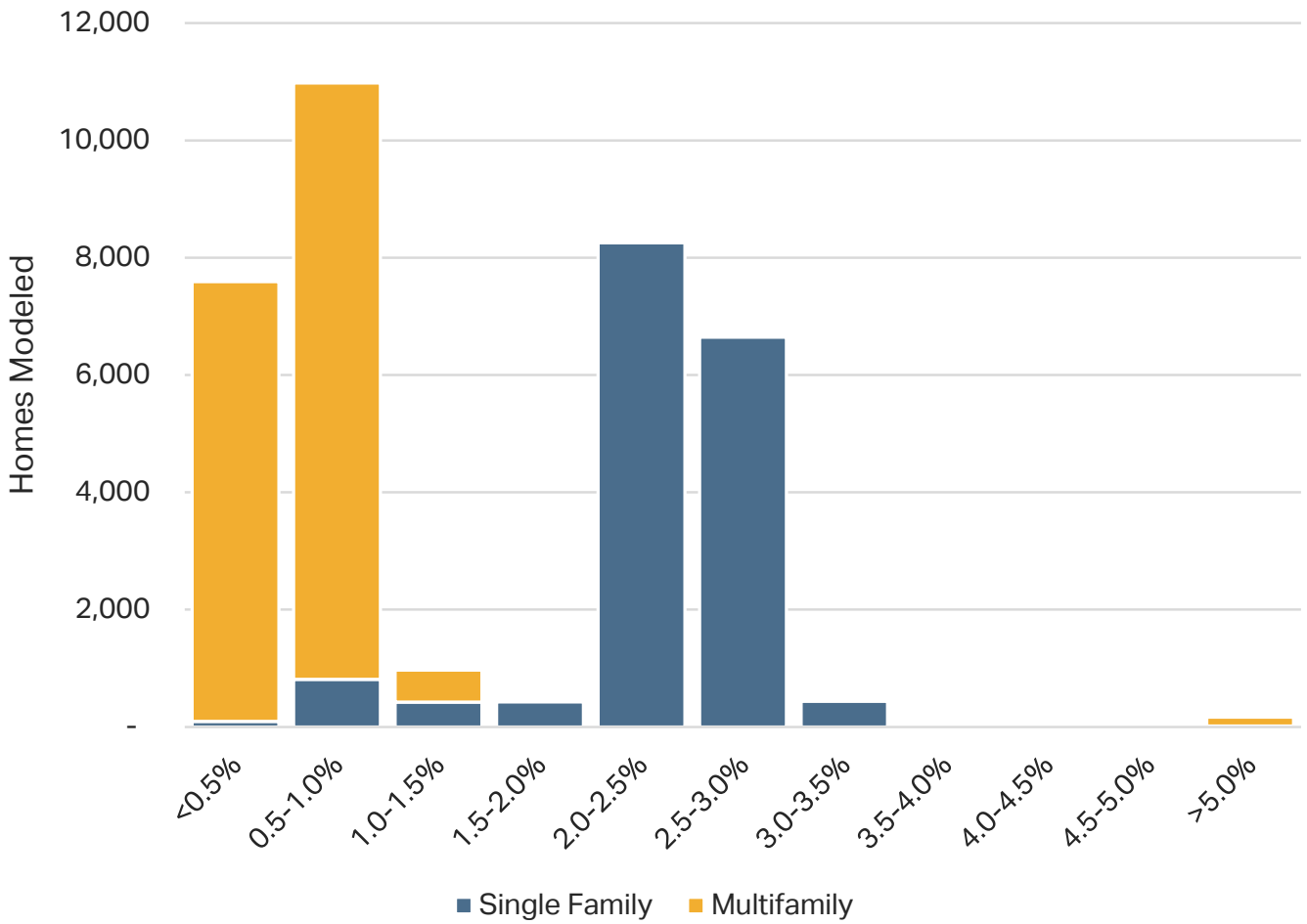
These results are bolstered by the supply-side impacts not modeled in this report. Higher-performance products can minimize future investments in transmission and distribution infrastructure and mitigate grid load management challenges associated with building electrification. Homeowners considering solar and battery storage systems see similar benefits, with the appliance efficiency improvement allowing homeowners to achieve NZE performance with smaller solar systems (1.2 kW smaller on average). Modeling results also ignore the impact these higher-performing products have on user experience, where variable-speed air source heat pumps and induction cooktops are demonstrably superior to single-speed heat pumps and resistance cooktops.

Future analysis should incorporate the supply-side benefits of incentivizing these appliances and even higher-efficiency equipment, especially ductless mini-split heat pumps for heating and cooling. These systems provide unparalleled levels of efficiency and facilitate modular design that may reduce costs in some households, especially those homes where existing ductwork is in disrepair (ductwork repair costs were not considered in this report).

TARGET ENVELOPE UPGRADES FOR THE WORST-PERFORMING HOMES

Berkeley residents can further improve the operational cost impacts of an electrification retrofit by investing in light-touch building envelope upgrades like air sealing and increased roof insulation. As shown in Figure 3-6 energy modeling analysis shows that combining appliance efficiency investments with envelope upgrades yields lower utility bills for 90 percent of Berkeley homeowners.

Figure 3-6. ROI for Added Investment in Envelope Measures in Berkeley's Housing Stock



However, envelope efficiency upgrades were typically not cost-effective in the modeling for Berkeley, in part due to the Bay Area's mild climate and extreme local labor rates. Envelope efficiency measures fared particularly poorly in single-family homes—this belief may be a result of the greater exterior surface area (and thus greater cost for improvement) in these homes. Envelope efficiency investments fared even more poorly when solar PV was incorporated in the package to reduce the $/kWh electric rates incurred by Berkeley homeowners.

These modeling results clearly show that envelope investments are regarded as unfeasible financially for the average Berkeley homeowner. However, these upgrades can be a valuable addition for Berkeley's worst-performing homes, with those homes often occupied by the Berkeley constituents who can least afford to pay higher bills. Envelope upgrades in these homes may occasionally allow heat pump installers to size smaller products and can prevent comfort complaints when heat pump ASHPs are installed.

Envelope investments can also provide load reduction and management benefits that will only become more valuable as Berkeley's grid electrifies. Furthermore, envelope improvements provide non-monetary benefits including comfort during extreme temperatures and ability to maintain better indoor air quality during poor outdoor air quality events such as wildfire smoke.

These results suggest that Berkeley should not mandate envelope upgrades until typical project economics improve significantly. In the meantime, Berkeley should consider reserving funds for upgrading the envelopes of the most poorly performing homes. These homes could be effectively targeted through utility meter data analysis or contractor engagement.

MULTIFAMILY AND LOWER-INCOME RESIDENTS NEED TARGETED SUPPORT

Modeling results show that owners of low-rise multi-family housing units and smaller single-family homes can typically electrify gas appliances more cost-effectively than larger single-family homeowners. However, this appears to largely be a result of the PG&E E-1 tiered rate tariff modeled for this report: occupants of larger homes often pay a higher utility rate for newly-electrified loads than residents of multi-family and small single-family homes under this tariff structure. Multi-family units and smaller homes see their advantage disappear in the more cost-effective electrification + solar packages (e.g., packages 1.2, 1.3, 2.2, and 2.3) that utilize a rooftop solar PV system to manage electricity costs. Table 3-5 shows the different incentive levels required by different housing types for cost-neutral financing under the terms modeled in this report.

Table 3-5. Average Incremental Cost for Electrification With Rebates and Financing[116]

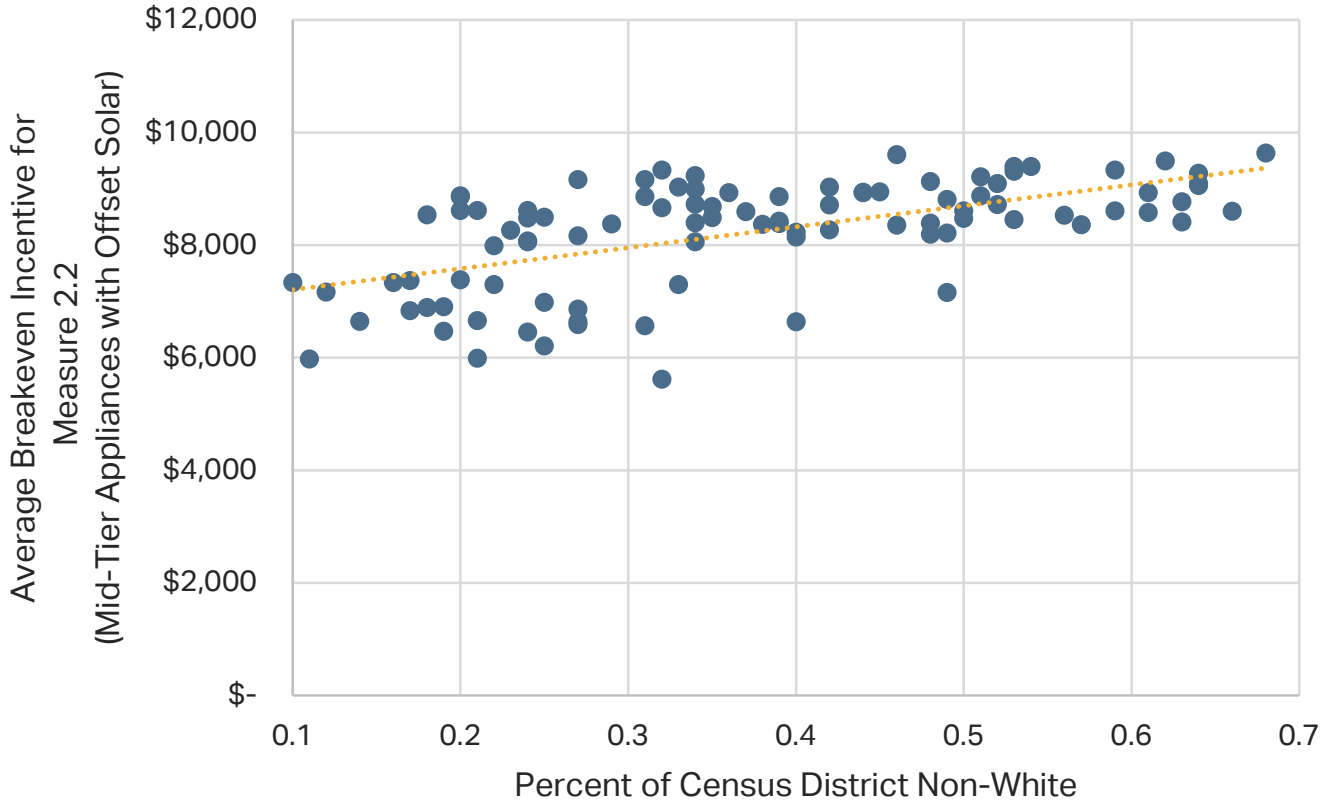
	Single-family			Multi-family	
	Under 1,500 ft²	1,500-3,500 ft²	Over 3,500 ft²	Under 1,000 ft²	1,000 ft² and over
1.1: Economy Appliances	$12,770	$15,350	$19,220	$9,730	$11,980
1.2: Economy Appliances + Offset Solar	$5,710	$4,130	$2,770	$6,550	$5,940
1.3: Economy Appliances + NZE Solar	$1,190	$0	$0	$2,770	$1,300
2.1: Mid-Tier Appliances	$10,090	$10,620	$11,850	$9,190	$9,790
2.2: Mid-Tier Appliances + Offset Solar	$6,100	$3,970	$1,990	$7,550	$6,500
2.3: Mid-Tier Appliances + NZE Solar	$1,720	$0	$0	$3,990	$1,780
3.1: Mid-Tier Appliances + Envelope	$12,010	$16,180	$22,500	$9,700	$13,020
3.2: Mid-Tier Appliances + Envelope + Offset Solar	$8,930	$10,960	$14,190	$8,270	$10,150
3.3: Mid-Tier Appliances + Envelope + NZE Solar	$4,300	$4,310	$4,870	$4,550	$5,090

116 *These costs represent the upfront incentive necessary to achieve cost-neutral financing under the terms dictated earlier in this report.*

These results suggest that larger single-family homes are likely to see disproportionate benefits under time-of-use and other non-tiered electric rate tariffs.

The correlation between financial returns and home size and type has serious implications for ensuring an equitable transition toward all electric buildings. Berkeley's smaller homes are disproportionately occupied by lower income residents and BIPOC community members who are more likely to experience energy insecurity[117]. As a result, the least profitable candidates for electrification in Berkeley are often occupied by the residents who can least afford to carry that burden. Targeted incentives are necessary to ensure that the financial impacts of building electrification do not diverge along socioeconomic lines. This is exemplified in Figure 3-7, which shows a correlation between the racial makeup of Berkeley communities and the incentive necessary to cost-effectively electrify that community's homes:

Figure 3-7. Cost of Electrification by Racial Makeup in Berkeley Census Districts[118]

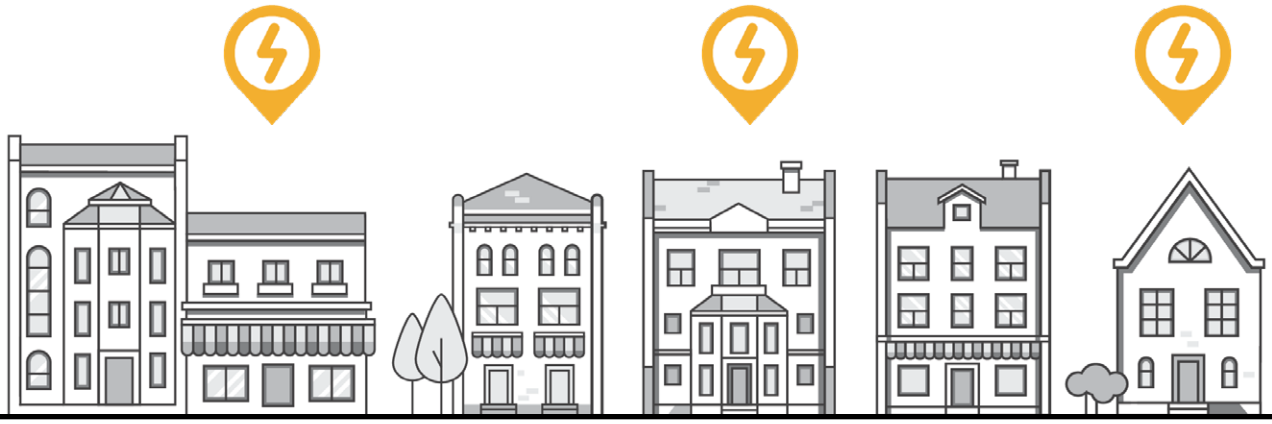


117 *Energy insecurity: The inability of a household to meet its basic energy needs.* https://www.nature.com/articles/s41560-020-00763-9

118 *These costs represent the upfront incentive necessary to achieve cost-neutral financing under the terms dictated earlier in this report.*

These results do not account for other challenges unique to electrifying multi-family buildings including a greater range in system configurations, the split incentive issues caused by a prevalence of rental properties, between owners and tenants in rented properties, and a lack of access to rooftop solar. Nor do they account for the fact that past programs intended to reduce greenhouse gas emissions and promote renewable energy have been disproportionately utilized by affluent residents.[119] The City also understands that there are varying different types of property owners, including large-scale commercial property owners, property owners with a few small properties, and low-income property owners. Additional support such as funding and subsidies will need to be directed to low income property owners, such as individuals who own a small rent-controlled and/or owner occupied building.

119 *Eric Daniel Fournier, Robert Cudd , Felicia Federico , Stephanie Pincetl; On Energy Sufficiency and the Need for New Policies to Combat Growing Inequities in the Residential Energy Sector. UCLA's California Center for a Sustainable Economy, June 2020. Accessed at https://online.ucpress.edu/elementa/article/doi/10.1525/elementa.419/112771/On-energy-sufficiency-and-the-need-for-new.*



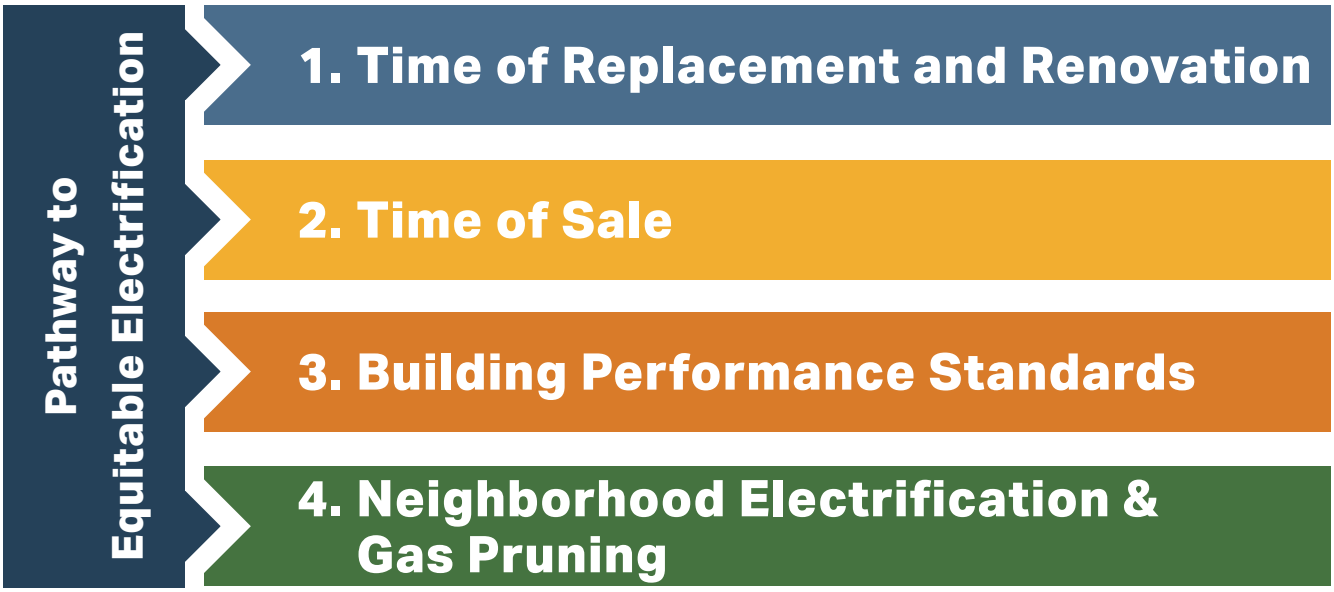
4. EXISTING BUILDINGS ELECTRIFICATION STRATEGY

4.1 EXISTING BUILDINGS ELECTRIFICATION STRATEGY

4.1.1 A STRUCTURAL APPROACH TO EQUITABLE BUILDING ELECTRIFICATION

Completely electrifying Berkeley's building stock will require a combination of new and modified policies by the local, State, and federal governments. Berkeley's Existing Building Electrification Strategy examines a wide variety of actions and policies to promote or require electrification of Berkeley's existing buildings to achieve full scale electrification of buildings–once equitably cost-effective and feasible–by 2045 or sooner if possible. Each of the actions falls under one of four primary policies:

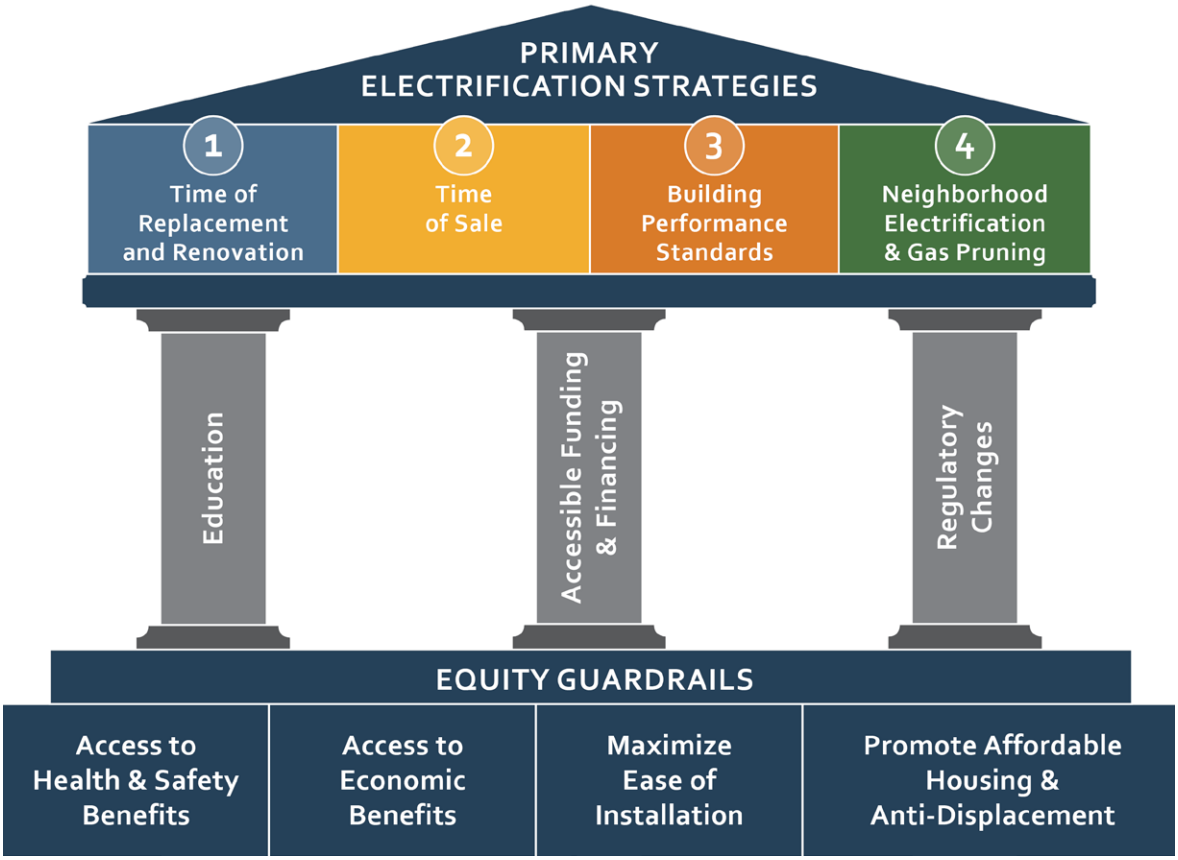
Figure 4-1. Pathway to Equitable Electrification



Each of these four policies represents a specific strategy through which the City of Berkeley can incentivize or require building owners to electrify. Each policy has its own specific hurdles and opportunities and will be discussed in more depth in the following chapters.

No single policy will be sufficient to electrify Berkeley's existing buildings by 2045. Rather, a strategic approach to pursuing each of these policies in concert will be required to achieve the goal of a fossil fuel-free Berkeley. As the building electrification area is dynamic and rapidly changing, the City will work with the community and track opportunities at the State and Federal levels to determine how and when each policy will be used, and the applications to various building types. These policies will require successful support from the three essential pillars that must be built up for implementation–**education, accessible funding and financing, and regulatory changes** (described in Section 4.1.3 below). Most importantly, the foundation of this work must be grounded in equity and in the tenants of targeted universalism defined in Chapter 2.0. Before the policies can be implemented, they must meet or exceed the **equity guardrails**, described in Section 4.1.2. Figure 4-2 shows a visual representation of this structure. Each element is described in the following sections.

Figure 4-2. Existing Buildings Electrification Structural Approach



4.1.2 FOUNDATION ROOTED IN EQUITY

Meeting the goal of transitioning all existing buildings off gas requires a strategy centered in equity and access. The building electrification movement will not be completely successful if it does not directly address and work to reverse systemic inequities seen in the building sector. As discussed in Chapter 2.0, marginalized communities within the City of Berkeley have experienced systematic discriminatory practices in the past that continue to have ramifications today.

Through engagement and collaboration with community members, organizations, and key stakeholders/partners, a set of equity guardrails was developed (Chapter 2.0) to ensure that the electrification of existing buildings does not come at the expense of the communities most adversely impacted and that benefits to those communities are maximized. The equity guardrails are intended to serve as a set of minimum requirements that must be met prior to implementation of the recommendations of this report. Each guardrail is key to becoming a fossil fuel-free city and being carbon neutral by 2045.

For each policy in this report, a review of the equity guardrails has been conducted. For each equity guardrail, the opportunities and risks to equitable implementation of the strategy are highlighted. In addition, potential solutions to the identified risks and the corresponding actions are also identified. The equity guardrails were used to review each policy to identify and mitigate unintended impacts to the community moving forward. The potential solutions (which take the form of additional actions and modified action language) are based on feedback from the community and research by the team. The City will continue to work with the community to identify and co-create additional solutions during the plan's implementation as new approaches, technologies, and impacts are identified and addressed. An example layout of the equity analysis that can be found at the beginning of each policy section. For the complete equity guardrails analysis please see the corresponding policy sections.

One of the major risks associated with a time of replacement ordinance (a requirement to replace a gas appliance with an electric one when it breaks) is the higher upfront costs associated with the electric appliance. While appliances like heat pump HVAC and hot water heaters offer long term savings and benefits like healthier air and built-in AC, the community feedback the City received noted the upfront costs as a significant hurdle for marginalized communities. Because of this, the time of replacement and renovation policy did not pass the Access to Economic Benefits guardrail on its own, since many households would simply not be able to afford the upfront costs associated with the replacement under current conditions. To help solve this issue, there are specific actions in Chapter 4 to ensure that the time of replacement ordinance would not be mandated until accessible funding and financing mechanisms were in place to support the community in this transition.

This process was followed for each of the policies and served as a mechanism to determine what additional targeted approaches were needed to meet the universal goal of electrification of the building stock.

4.1.3 THREE SUPPORTING PILLARS FOR SUCCESSFUL IMPLEMENTATION

Electrification of existing buildings will require long-term and systematic changes to many of the systems that exist today. The multi-faceted approach highlights the four primary strategies that the City of Berkeley can utilize as the City progresses towards existing building electrification. However, in order to ensure successful implementation of the policies, the three pillars of **education, accessible funding and financing, and regulatory changes** are essential to creating policies that will engage, invest in, and support the entire community through the transition away from fossil fuels. To ensure each policy can be effective, equitable, and feasible, these pillars must be built up and strengthened. Each action under the policies should support at least one of the essential pillars of effective policy development. The chapters below include detailed descriptions of how each of the pillars will be implemented.

Education

While electrification is not new, there are new and improved technologies, and many benefits to electrification that are not widely known. Induction stoves and heat pump technologies have revolutionized all-electric buildings. On-site solar generation can reduce the cost of electricity and when combined with battery storage can provide back-up power, enhancing resilience. Providing ongoing education on new technologies and their benefits is a key step to achieving widespread adoption, and many community members have expressed this need. Additionally, providing education on new requirements, incentives, policies, and programs as they are phased in will be another critical step to successfully implementing the policies outlined in this report. Robust and targeted education strategies need to be provided to a wide range of stakeholders including the community with a focus on marginalized communities, renters, landlords, homeowners, contractors, labor unions, and businesses. It is important that this education is culturally relevant and responsive, and that it addresses concerns and/or considerations certain groups have related to how they use their homes/buildings, such as cooking traditions and cultural businesses and practices. With each pilot project and discussion with the community, education strategies can be updated and honed, which in turn will inform the success of future projects and community engagement.

Accessible Funding and Financing

One of the key pieces of feedback the team heard from the community is that costs matter, and that increased costs for equipment, increased bills, and increased debt are all not acceptable or possible for many low- and moderate-income (LMI) people who are already struggling financially. The impacts of COVID-19 are exacerbating these financial challenges.

Upgrading Berkeley's building stock to be all-electric will come with upfront costs to both owners and renters in comparison to standard gas equipment, at least in the short term. Although electrification will likely save money over time, especially as gas prices are projected to increase, addressing these upfront costs will be critical to the success of the overall program to ensure LMI communities are not left behind paying higher utility costs and not having access to the benefits of electrification. Thus, ensuring sufficient funding and financing options are accessible to renters, homeowners, and landlords–with a focus on frontline communities in each of these groups–is a key measure that will allow each of the four primary policies to be implemented in an equitable manner. For more information on the funding and financing strategies see Section 3.3.

Regulatory Changes

Phasing out gas and other fossil fuels from buildings will require significant changes to the regulations and systems that currently support our buildings and infrastructure. These could include policy changes that allow reprioritization of resources, changes to permit requirements, or regulations on appliances and fuel use, while assuring tenant protections. Berkeley has strong tenant protections, and all programs and policies should collaborate to elevate existing and future tenant protection programs.[120] Regulatory change will be required to drive electrification, but only when supported by the other pillars. While the City cannot drive this change alone, it can work to coordinate with other jurisdictions and agencies to advocate for these changes.

120 Please see Rent Board comments in Appendix B

4.1.4 FOUR PRIMARY POLICIES

1. Electrification at Time of Replacement and Renovation

The time of replacement policy focuses on replacing fossil fuel equipment at the end of its useful life, either when the gas equipment fails or when a major building renovation is taking place. This policy's major benefit is that time replacement and renovation is the most cost-effective time to install electric heating/cooling systems and appliances, because the marginal cost (difference between installing electric equipment and replacing with new gas equipment) at this time is smaller than the full cost of installing electric equipment. For example, when replacing a malfunctioning gas hot water heater with a heat pump hot water heater, the incremental cost difference between the gas unit and the electric unit is much lower than the total installation cost of a new heat pump water heater, although the installation may require additional electrical work, such as rewiring and panel upgrade.

A major building renovation is an ideal opportunity for electrification. During major construction, upgrades to wiring, appliances, and electric panels are likely to be more cost effective. Supporting electrification during these times will be a key strategy for cost effective electrification and education about electrification. However, time of replacement electrification can be piecemeal and does not allow for the significant lifecycle savings associated with removing gas infrastructure altogether.

2. Electrification at Time of Sale

Time of sale requirements are triggered when a building changes ownership. This policy area generally applies to single family homes since they are sold more frequently than other types of buildings. Time of sale requirements are included in Berkeley's existing Building Emissions Saving Ordinance (BESO)[121] and could be expanded to include a range of required measures such as electrification-ready panel upgrade, appliance replacement or whole building electrification and incentives for electrification work.

121 *https://www.cityofberkeley.info/BESO/*

Benefits of a time of sale requirement include the ability to complete work prior to occupancy and the ability to tie the upfront costs of electrification to a building's mortgage. The major drawbacks to time of sale requirements are the added burden to an already expensive housing market and the relatively low number of buildings covered by the requirements on an annual basis (on average 2–3 percent of buildings are sold in Berkeley).

3. Building Performance Standards

Building performance standards establish building-level requirements such as minimum GHG emissions standards or elimination of gas by a specified date for covered buildings. These standards are generally applied to larger buildings, including multi-family residential and commercial buildings, in order to have the highest impact on the largest energy users. The size and type of building covered by such an ordinance could expand over time. Berkeley has already amended the BESO to include the development of minimum performance standards for large buildings (buildings over 25,000 square feet) that would be required on a specified schedule. These standards would require buildings to decrease gas usage and electrify to meet their targeted emissions standards. The success of this policy will depend on tenant protections as well as overcoming the financial challenges posed by split incentives[122] and technical challenges of retrofitting high-rise multi-family, commercial, and mixed-use buildings.

4. Neighborhood Electrification and Gas Pruning

Neighborhood electrification and gas pruning covers a wide range of actions that affect how Berkeley can strategically reduce and eventually eliminate gas infrastructure in the city. Removing gas infrastructure will reduce methane leakage which has health, safety, and climate impacts. Neighborhood-level electrification can be a more equitable way to electrify communities as opposed to a building-by-building approach which will leave those who cannot afford to electrify first with higher gas rates. It also allows for neighborhood beneficial electrification with a greater potential for high road[123] jobs for large scale projects that incorporate resilience measures such as on-site solar and islandable backup battery storage that could act as a neighborhood micro-grid to improve energy

122 *Split Incentives occur when those responsible for paying energy bills (the tenant) are not the same entity as those making the capital investment decisions (the landlord or building owner). In these circumstances, the landlord may not be inclined to make the necessary upgrades to building services when the benefits associated with the resulting energy savings accrue to the tenant. https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/Infrastructure/DC/IOU%20SJV%20Split%20Inc%20Wkshop_Pres_FINAL_01.28.19.pdf*

123 *"High road" employers pay family supporting wages, compete based on the quality of their services and products, and engage workers and their representatives in the project of building skills and competitiveness (California Workforce Development Board, 2018: https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpucwebsite/content/utilitiesindustries/energy/energyprograms/infrastructure/dc/sjvsplitincentivejointiou.pdf).*

assurance. The long-term goal would be to shift public investment from aging gas infrastructure toward neighborhood-scale building electrification.

Infrastructure pruning would take place when a gas line is ready for repair or replacement or otherwise requires investment. Although several legislative hurdles exist today, the potential to reallocate funding from the repair or replacement of a gas line to electrification could be a major funding opportunity in the future. Instead of spending money to replace the gas line, some fraction of that cost could instead be used to electrify the buildings attached to the line. Neighborhood scale electrification could also reduce project costs by benefiting from economies of scale such as bulk purchase discounts and reduced labor and transaction costs. The challenges of infrastructure pruning include the high upfront cost of neighborhood electrification and finding a location that meets technical, financial, equity, and community considerations.

Additionally, neighborhood level electrification, with potential different impacts to homeowners and renters, requires participation from all property owners and residents. Tenant protection policies would need to be in place to reduce risk of gentrification and/or displacement. The creation of a pilot project could assist in identifying and overcoming regulatory and financial barriers that arise in the decommissioning of gas distribution infrastructure and upgrading electric infrastructure capacity.

4.1.5 CROSS-CUTTING MEASURES

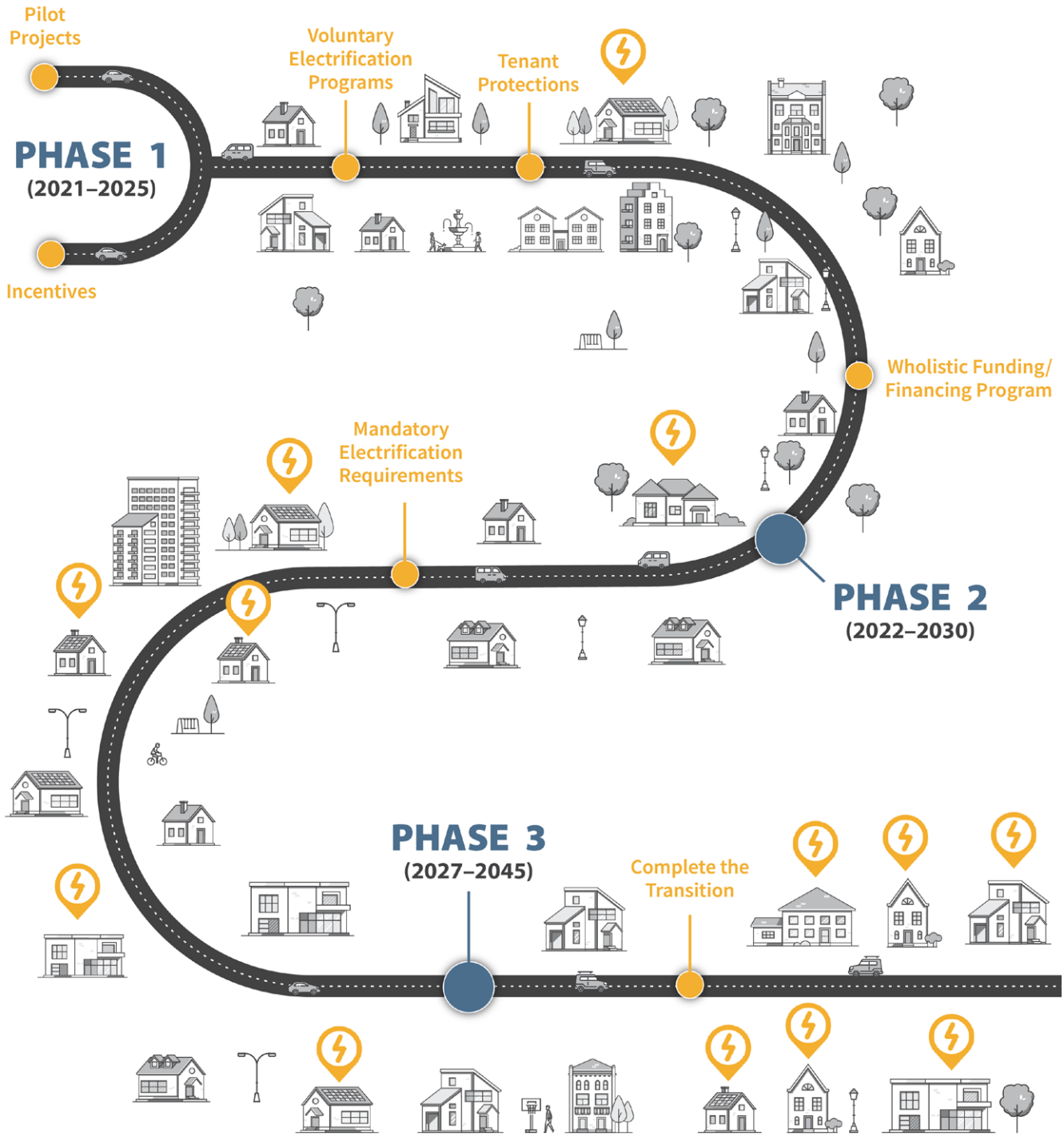
In addition to the four primary policies for advancing existing building electrification, there are also cross-cutting actions that do not fall directly into one of these policies but will support the overall success of electrification both in the city and beyond. Many of these actions cannot be taken by the City alone and will need wider collaboration from regional partners and the State.

4.1.6 TIMELINE FOR IMPLEMENTATION

The equity guardrails will influence the timing of the implementation of each of the actions and policies. The City will be able to implement a specific action only after a policy can pass the equity guardrails. Therefore, some policies, like mandatory electrification requirements, may not be implementable until other supportive actions such as accessible funding and financing are widely available. Feedback from the community stressed the importance of an application of the equity guardrails over an aggressive timeframe. Rather than a strict implementation schedule, the actions within each strategy have been broken into three phases to lead with equity. These phases are based on available data, technology, and anticipated equity impacts. Phase 1 focuses on expanding and verifying the cost effectiveness and equity impacts identified in this report, implementing foundational programs, and building community capacity. Phase 2 increases the stringency of the policies and begins to introduce mandatory measures, once sufficient supports are in place. Finally, Phase 3 policies finalizes the move toward all-electric buildings through mandatory measures. Berkeley will need to act as quickly as possible to move through the phases in order to achieve complete building electrification by 2045.[124]

124 See Chapter 3 for a full description of level of effort for achieving complete electrification by 2045.

Overview of Building Electrification Timeline



PHASE 1

(2021–2025)

Phase 1 actions will lay the groundwork to support widespread transition to electrified buildings in Berkeley. Policies included in Phase 1 will involve continued community engagement, pilot projects, education campaigns to demonstrate the benefits and feasibility of electrification, collaboration with labor and workforce organizations to advance inclusive high road jobs, alignment of existing programs and incentives, and the development of additional incentive programs as well as larger scale funding and financing programs such as tariffed on-bill financing. The City of Berkeley will work with partners such as East Bay Community Energy and Pacific Gas & Electric (PG&E) to develop larger scale Phase 2 projects. There will also be a need to collaborate with regional and State partners to align State policies to support Phase 2 actions. It is expected that Phase 1 actions would be implemented over the short- to mid-term with a goal of completion by the end of 2025.

PHASE 2

(as soon as possible, no later than 2022–2030)

Policies included in Phase 2 include implementation of the core policies, including mandating specific portions of electrification at points of sale, lease, renovation, and as part of a building performance standards program. This phase would also include advancing neighborhood scale electrification. Phase 2 actions would be implemented after Phase 1 actions have demonstrated feasibility, cost effectiveness, and best practices. Some Phase 2 actions will need to be implemented only after an accessible funding/financing program is in place or upfront costs of electrification reach parity with gas infrastructure. There may be some overlap with Phase 1 and Phase 2 actions.

PHASE 3

(as soon as possible, no later than 2027–2045)

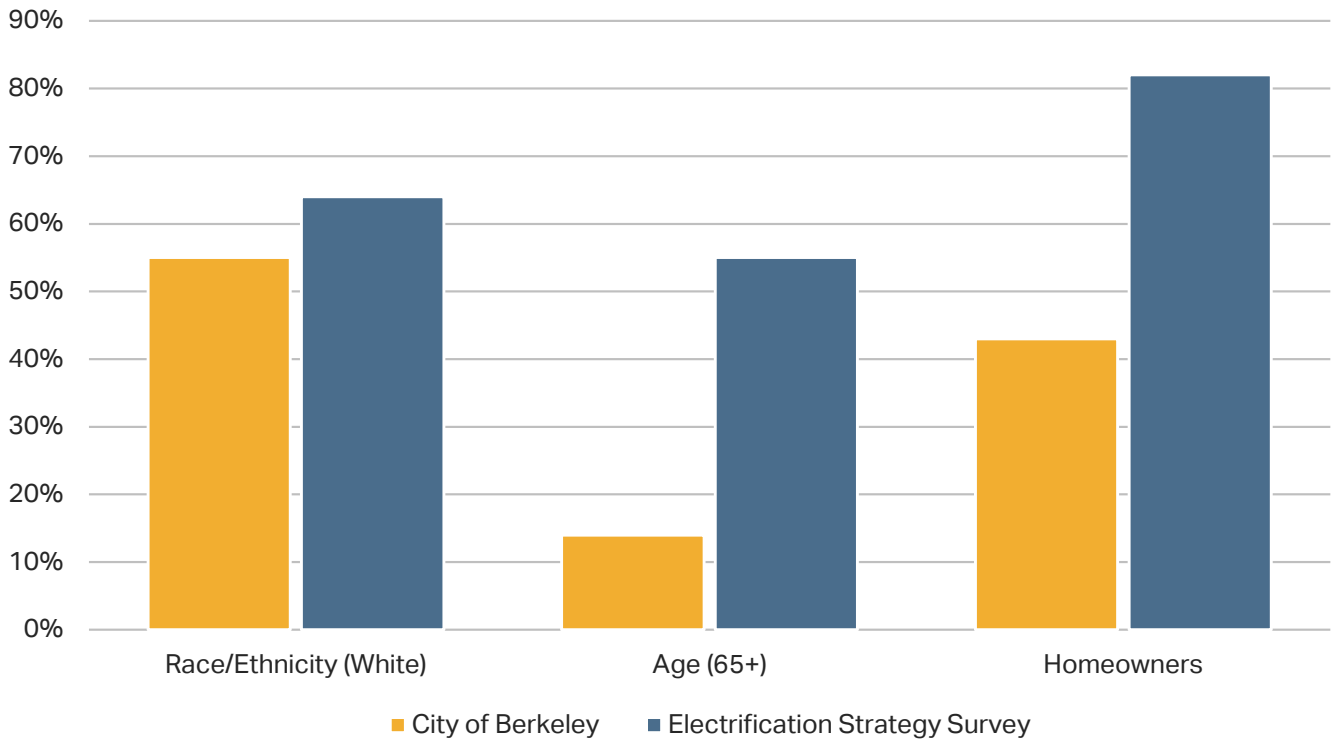
Phase 3 policies complete the transition to full building electrification. Phase 3 policies include bans on the use of gas and other permanent or mandatory measures that define an end to gas use in Berkeley. Phase 3 policies would be implemented once Berkeley is well on its way to complete electrification and the prerequisite actions including pilots, funding and financing programs, and several years of education have been completed. There may be some overlap with Phase 2 and Phase 3 actions.

4.1.7 THE IMPACTS OF TARGETED ENGAGEMENT ON STRATEGY DEVELOPMENT

Throughout the course of the development of this report, the team conducted traditional outreach with public meetings, technical advisory meetings and presentations to the Berkeley Energy Commission (see Section 2.5). Additional efforts focused on a targeted approach to community engagement, with in depth discussions with community organizations representing marginalized communities and smaller, often one-on-one meetings, trying to meet people where they are, rather than asking them to come to us. This approach provided opportunities to listen and learn from our communities that do not usually attend more "traditional" outreach events, public forums or online surveys.

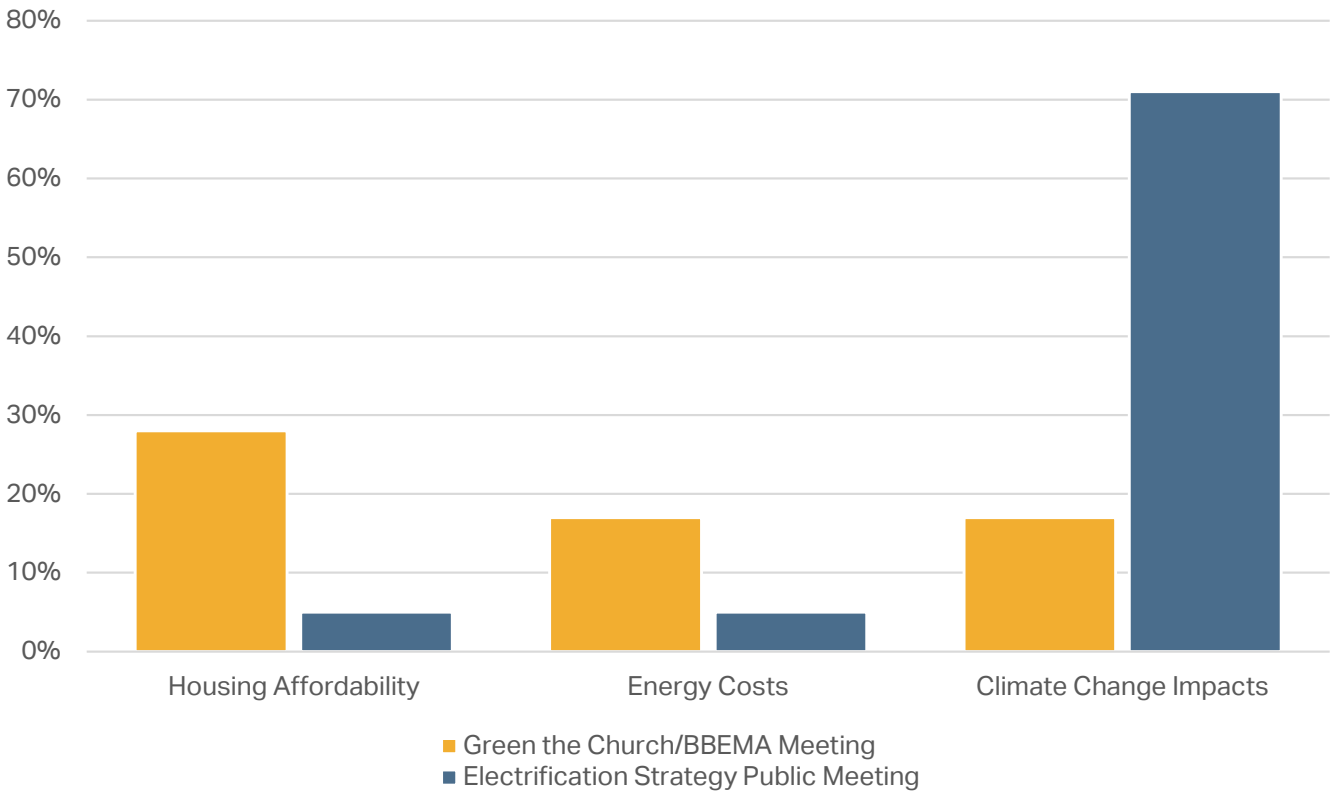
When considering feedback from the various methods of outreach and engagement, it is also important to note who participates in more traditional forums, and how priorities compare to the more targeted outreach where the team went to meet community organizations representing marginalized communities. For example, as seen in the figure below, public survey respondents disproportionally represented a higher percentage of White homeowners over the age of 65 than the general population, based on reported demographic information.

Figure 4-3. Overall Demographics in the City of Berkeley Compared to Survey Respondents



Additionally, a much higher percentage (more than 70%) of those who attended the traditional public meeting focused on building electrification reported climate change impacts as their top priority, as opposed to any other area (such as housing affordability, racial justice, energy costs), whereas at the targeted engagement meetings with organizations representing people of color, such as the Berkeley Black Ecumenical Ministerial Alliance (BBEMA), attendees named a wide range of priorities, with housing affordability being the most common and climate change impacts being 17%.

Figure 4-4. Green the Church/BBEMA Focus Groups vs. Public Meeting Responses to the Question: "What is Your Long-Term Priority?"



This data serves to show the need for local governments to seek out the voices not usually heard at open traditional meetings focused on climate and environment and outreach tools, such as online surveys, to broaden input on policies and decisions. These unheard voices are critically important, representing the people who have been marginalized and are also those hit first and worst by climate change. The goal of inclusive and equitable electrification strategies is for this targeted engagement to build trust and ongoing relationships with the City. Engaging all community members in electrification barriers and solutions, ensures that policies and programs will be equitable and able to scale to the entire community.

4.1.8 ELECTRIFICATION POLICIES AND ACTIONS

Table 4-6 provides a summary of the four electrification policies and the supporting actions. The table denotes the expected phase of implementation as well as if it supports the pillars of education, regulatory changes, and accessible funding and financing. The equity considerations for each action are in the Equity Guardrails Analysis at the beginning of each Policy (Chapters 4.2-4.6). Each Policy Chapter also includes additional detail about the policy, its phasing, and each supporting action.

Table 4-6. Policy and Action Summary Table

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
Cross-Cutting Measures					
CC-1	Collaborate with regional and State partners to support rate structure changes at the CPUC that fairly reflect the current and future costs of gas and electricity.	1		⚡	
CC-2	Continue to analyze cost effectiveness based on evolving electricity rates, including time-of-use rate changes.	1		⚡	
CC-3	Expand analysis of building electrification to commercial and industrial buildings.	1			
CC-4	Support technological improvements around battery storage, demand management, and "retrofit-ready" heat pump products.	1			
CC-5	Develop equity performance metrics to gauge success in collaboration with marginalized communities.	1			
CC-6	Collaborate with community organizations to provide culturally-sensitive educational resources to support outreach and engagement.	1	⚡		
CC-7	Collaborate with partners such as utilities and other funding entities to develop accessible and affordable financing options (for renters and homeowners), such as tariffed on-bill financing programs.	1			⚡

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
CC-8	Explore funding opportunities for programs supporting equitable electrification, including integration of electrification measures into housing protection and preservation programs, such as the City's Senior and Disabled Home Loan Program or Section 8 housing voucher program.	1			⚡
CC-9	Leverage and Expand Existing Tenant Protection Programs to Tie Tenant Protections to Electrification Incentives to Ensure Building Upgrades Don't Result in Increased Displacement.	1			⚡
CC-10	Lead city participation in High Road Training Partnership (HRTP) grant for High Road to Residential Building Decarbonization with Rising Sun Center for Opportunity and other partners.	1	⚡		
CC-11	Link disadvantaged Berkeley residents to training programs that prepare them to enter and succeed in union construction careers by supporting and collaborating with local MC3[125] workforce partners, employers/contractors, Berkeley Unified School District (BUSD), Peralta Community Colleges and community organizations to develop and sustain inclusive training opportunities and a long-term pipeline of work in the building retrofit market that carries high road labor standards.	1	⚡		
CC-12	Collaborate with the Construction Trades Workforce Initiative and the Building and Construction Trades Council of Alameda County to shape policies and labor standards leading to inclusive, family–sustaining union construction careers for underrepresented communities.	1	⚡		

125 *Multi-Craft Core Curriculum (MC3) Building Trades Curriculum pre-apprenticeship training standard set by the California Workforce Development Board. https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/10/HRCC_Building-a-Statewide-System-of-High-Road-Pre-Apprenticeship-in-California_ACCESSIBLE.pdf*

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
CC-13	Identify opportunities to advance high road, union jobs with the following tools and labor standards: 1. Certification, apprenticeship, or other worker skill requirements to engage a skilled and trained workforce; 2. Healthcare, pension, wage standards, such as prevailing wage requirements; 3. Contractor prequalification based on evidence of a skilled and trained workforce, abidance with building code and labor laws, and a history of quality workmanship; contribution to state-approved and/or Joint Apprenticeship Training Committee (JATC) apprenticeship programs 4. Best-value contracting for public and institutional buildings; 5. Quality assurance and quality control processes to ensure equipment is installed, commissioned, and operating as designed; 6. Regional targeted hire requirements to ensure the participation of disadvantaged workers and/or graduates from approved MC3 pre-apprenticeship programs; 7. Community workforce agreements. 8. Identify public funding, such as a municipal decarbonization bond, to support large scale electrification pilot projects, such as neighborhood scale electrification in historically disinvested communities, with Labor Standards	1			

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
CC-14	Support union contractors by: 1. Aggregate projects to attract union signatories to bid and build this work. 2. Create a preferred contractors list that promotes the use of union signatory contractors for homeowners. 3. Explore aligning City funding for municipal projects to meet the threshold for Project Labor Agreement project dollar thresholds by aggregating electrification projects to produce high quality work with high-quality jobs.	1			
CC-15	Create robust monitoring and enforcement programs to monitor employment agreements and assure high road jobs.	1			
CC-16	Explore coordinating and partnering with weatherization program providers to support electrification education and upgrades for eligible households.	1	⚡		
CC-17	Develop incentives for businesses that convert to all-electric. Prioritize resources for small and longer standing businesses.	1	⚡		⚡
CC-18	Develop public education campaigns and resources to promote new City programs and the benefits of energy efficient systems and appliances; provide information on systems and requirements; and link homeowners to a list of pre-qualified contractors.	1	⚡		
CC-19	Enact a fee on gas equipment with equity exceptions for users. Utilize revenue to incentivize electrification.	2		⚡	⚡
CC-20	Develop a comprehensive funding/financing plan to direct electrification investments in marginalized communities.	2			⚡

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
CC-21	Explore the feasibility of a bulk purchasing procurement program to acquire appliances and electric panels at a discounted rate through a pilot project.	2			⚡
CC-22	Collaborate with the City's Rental Housing Safety Program to explore opportunities to include electrification and energy efficiency requirements in the program. Include accessible funding and financing mechanism to offset marginal cost increases in return for tenant protections.	2		⚡	⚡
CC-23	Adopt a "no reconnection to gas" policy as a way to eliminate PG&E's obligation to serve gas to an all-electric building in the future.	2		⚡	⚡
CC-24	Develop program for time of new lease and/or rental license electrification requirements.	2		⚡	
CC-25	Adopt and implement program for time of new lease and/or rental license electrification requirements.	3		⚡	
CC-26	Collaborate with regional and state partners to modernize the California Public Utilities Commission's obligation to serve requirement to refer to the need to provide affordable and reliable energy, without regard to the energy source.	3		⚡	
CC-27	Secure funding and subsidies particularly for low-income property owners and renters to reduce upfront costs of electrification and support rent stabilization to prevent displacement.	3		⚡	⚡

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
Time of Replacement and Renovation					
TR-1	Develop programs and incentives to target specific end-uses, such as HVAC or hot water systems.	1	⚡		⚡
TR-2	Provide culturally-sensitive education to the community on benefits of electrification at time of replacement/renovation and signal long-term phase out of gas by 2045.	1	⚡		
TR-3	Work with partners like EBCE, PG&E, and others to tie incentives for purchasing heat pump water heaters and HVAC units to electric heat pump permits to allow for direct installations, especially for LMI homes.	1			⚡
TR-4	Conduct electrification retrofit pilot with either deed restricted income qualified housing or naturally occurring low income housing with antidisplacement tenant protections.	1		⚡	⚡
TR-5	Work with partners like EBCE, PG&E, BAAQMD and others to begin developing an accessible funding/financing strategy for replacement of appliances, like accessible tariffed on-bill financing, to support widespread electrification.	1			⚡
TR-6	Develop policies to enhance tenant protections for adequate, appropriate, accessible housing security during renovations especially for those with disabilities.	1		⚡	⚡
TR-7	Develop program to educate community on economic benefits of upgrading HVAC and AC to a single heat pump unit at time of replacement. Consider requiring all new AC installations to be heating and cooling heat pumps.	1	⚡	⚡	

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
TR-8	Allow setback exemptions for heat pump condensing units and conduct a study of heat pump noise levels to exempt any models that fall under noise thresholds to streamline installation.	1		⚡	
TR-9	Adopt a time of replacement electrification policy for all municipal buildings.	1		⚡	
TR-10	Explore simplifying heat pump hot water heater permits where possible so that only one permit is required, as opposed to both plumbing and electrical permits.	1		⚡	
TR-11	Implement a time of replacement requirement for HVAC and hot water heaters once an accessible funding/financing option is available.	2		⚡	
TR-12	Implement a mandatory time of renovation upgrade program that provides a menu of upgrade options relating to electrification and efficiency during building renovation.	2		⚡	
TR-13	Adopt a reach code for substantial renovation or other electrification requirements at time of building permit.	2		⚡	
TR-14	Prohibit installation of gas equipment and/or permitting of any NOx emitting appliances in buildings.	3		⚡	
Time of Sale Actions					
TS-1	Consider incentive programs that would accelerate retrofits on residential properties, which could include electrification upgrades at time of sale.	1			⚡
TS-2	Collaborate with private and public partners to develop accessible financing and funding programs for homeowners such as mortgages and refinancing options.	1			⚡

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
TS-3	Develop mandatory time of sale energy upgrade requirements for BESO.	1		⚡	
TS-4	Include a Permit Compliance Review in the BESO Program to Ensure Appliances Were Replaced According to Electrification Requirements.	2		⚡	
TS-5	Adopt and implement mandatory time of sale energy upgrade requirements for BESO developed in TS-3, when accessible funding and financing is available.	2		⚡	
Building Performance Standards					
BP-1	Develop requirements for building performance standards for Berkeley's large existing buildings (25,000 square feet and over) that lead to the elimination of fossil fuel use, as per 2020 BESO amendment.	1		⚡	
BP-2	Adopt and implement performance requirements for buildings developed as part of BP-1.	2		⚡	
BP-3	Expand the existing BESO building performance standards (BP-1) requirement for multi-family and commercial buildings to include buildings under 25,000 square feet.	2		⚡	
BP-4	Develop tools, funding and financing to assist buildings with meeting building performance standard requirements developed as per 2020 BESO amendment, with extra support and tenant protections for LMI residents and small businesses.	2		⚡	⚡
BP-5	Consider applying fees associated with GHG emissions to accelerate elimination of gas and apply revenues to electrify LMI multi-family buildings, while providing tenant protections.	3		⚡	⚡

Action Number	Action	Phase	Education	Regulatory Changes	Accessible Funding and Financing
Neighborhood Electrification and Gas Pruning					
NE-1	Explore public funding mechanisms (e.g., a municipal decarbonization bond or carbon fee), and/or grants to support large scale electrification pilot projects, such as neighborhood scale electrification in historically disinvested communities, with inclusive high road union jobs and workforce development in partnership with organized labor.	1			⚡
NE-2	Develop a pilot project funding plan that allows flexible accounting to allow PG&E to demonstrate potential solutions to current regulatory financial barriers (such as gas vs. electrical assets, capital vs. expense accounting).	1			⚡
NE-3	Tie retrofit funding and financing packages related to neighborhood electrification and gas infrastructure pruning to non-displacement requirements.	1		⚡	
NE-4	Conduct a neighborhood electrification and gas pruning pilot with transparent community engagement.	1		⚡	
NE-5	Work with PG&E to develop a comprehensive strategy to guide gas infrastructure pruning and update based on changes to foundational issues identified in Phase 1.	2	⚡		
NE-6	Begin gas infrastructure pruning in areas where gas line repair/replacement is expected to occur as equity guardrails and foundational issues identified in Phase 1 are addressed.	2			

4.2 CROSS-CUTTING ACTIONS

Strategy Overview

In addition to the four primary policies developed to electrify the City of Berkeley's building stock, the following cross-cutting actions will support the overall electrification goals. By implementing these actions, the City will be able to remove many of the hurdles building electrification faces including funding and financing, equity impacts, and policy changes.

Phasing

Almost all of the cross-cutting actions are Phase 1 and focus primarily on making foundational changes that will pave the way for other more targeted electrification actions. Some cross-cutting actions will be implemented in later Phases and focus on expanding electrification requirements into hard-to-reach building types like rental housing.

Key Considerations

- High road workforce and job development.
- Contractor and community education.
- Accessible funding and financing programs.
- Tenant protections and affordable housing concerns.
- Regulatory changes.

PHASE 1–Cross Cutting Actions

ACTION CC-1: Collaborate with Regional and State Partners to Support Rate Structure Changes at the CPUC that Fairly Reflect the Current and Future Costs of Gas and Electricity.

Regulated utility rates have a major impact on the economics of electrification. Gas rates do not currently reflect the societal costs to climate, safety, and health and are thus artificially low in comparison to electricity rates, which include costs for social benefits, such as incentives for rooftop solar. Electricity rates also have inequities that need to be addressed. The City of Berkeley will work with its regional and State partners to support rate structure changes that better reflect the current and future cost of gas and electricity.

ACTION CC-2: Continue to Analyze Cost Effectiveness Based on Evolving Electricity Rates, Including Time-of-Use Rate Changes.

While the Strategy provides a clear snapshot of the economics of existing building electrification today, rapid changes are expected to take place over time. New technologies, rate changes, and other statewide policies are poised to change the cost effectiveness of building electrification in the short term. One major change is the implementation of time-of-use electricity rates. These rates will change the cost of electricity depending on the time of day, in the hopes of decreasing usage during periods of low renewable generation (early morning and late afternoon/evening). Time of use rates will significantly change the economics of electrification and may substantially increase the value of battery storage that can help eliminate electricity use during high rate charges.

ACTION CC-3: Expand Analysis of Building Electrification to Commercial and Industrial Buildings.

The Strategy focused on Berkeley's residential low-rise buildings which make up over 90 percent of the total buildings stock. However, the analysis did not cover Berkeley's commercial and industrial buildings which will also need to be addressed before the City can be fossil fuel free. Projects are currently underway to better understand the economics and technologies required to decarbonize these buildings, and future work will develop more robust cost analysis and requirements for these building types.

ACTION CC-4: Support Technological Improvements Around Battery Storage, Demand Management, and "Retrofit- Ready" Heat Pump Products.

New technologies will likely increase the cost effectiveness of building electrification and the City of Berkeley will continue to monitor their development and integrate them into future actions. Battery storage provides a resiliency opportunity, especially for people with disabilities and seniors who may be more vulnerable during power outages. While battery storage currently represents a major added cost to building electrification, the arrival of time-of-use rates may shift these economics in the near future. Additionally, retrofit ready products that use 120v instead of 220v are becoming available on the market and may reduce the need to include a panel upgrade in many homes. This equates to a savings of $3,000 or more, which is assumed to be the cost of a panel upgrade in the model used in this Strategy. Additionally, smart meters and other demand management technologies could further shift the need for panel upgrades by managing electricity loads in real time.

ACTION CC-5: Develop Equity Performance Metrics to Gauge Success in Collaboration with Marginalized Communities.

While this Strategy outlines the major equity concerns the team heard from the community and outlines specific actions to address them, performance metrics have not yet been established. The City of Berkeley will continue to work with the community, building on relationships developed through this process, to identify and co-create quantifiable and trackable metrics to gauge the success of the Strategy implementation and provide accountability.

ACTION CC-6: Collaborate with Community Organizations to Provide Culturally-Sensitive Educational Resources to Support Outreach and Engagement.

Education of the community on the benefits, technologies, and support programs available when electrifying existing buildings will be critical to the success of the overall Strategy. The City will continue to work with the community to develop educational resources that are culturally-sensitive, understandable, and provide pertinent information to the community. The outreach conducted to develop the Strategy was really the first step in a long process of community engagement and capacity building.

ACTION CC-7: Collaborate with Partners such as Utilities and Other Funding Entities to Develop Accessible and Affordable Financing Options (for Renters and Homeowners) such as Tariffed On-Bill Financing Programs.

The development of accessible funding and financing programs is one of the most critical actions needed to make building electrification equitable and cost effective and will require action from the City as well as other private and public partners. Based on the results described in Chapter 3, building electrification has increased upfront costs but can have long-term savings. Accessible financing has the potential to lower or remove these upfront costs and allow homeowners or tenants to pay for the equipment over time using their savings resulting in many more positive cash flow opportunities. Tariffed on-bill financing is one financing option that can be equitably applied throughout Berkeley including renters. A tariffed on-bill financing program could pay for some or all of the electrification project that then could be paid back over time through the electricity bill savings. This type of program is tied directly to the home/building and not to a person reducing many of the economic hurdles for LMI households. The City should consider a disclosure requirement for existing tenants prior to any tariffed on-bill financing agreements and in leases for prospective tenants if there is existing tariffed on-bill financing. While not widely available locally right now, tariffed on-bill financing has been applied in other states including the Pay-As-You-Save programs in Kansas, Michigan, and Hawaii.[126]

ACTION CC-8: Explore Funding Opportunities for Programs Supporting Equitable Electrification, Including Integration of Electrification Measures Into Housing Protection and Preservation Programs, such as the City's Senior and Disabled Home Loan Program or Section 8 Housing Voucher Program.

A number of rehabilitation programs are currently available to Berkeley residents which have the potential for expansion to include components that can improve opportunity for electrification.[127] The City of Berkeley's Small Sites Program, which works with nonprofits to purchase and rehabilitate existing multi-unit properties for affordable housing, presents opportunity to include electrification measures as part of building rehabilitation. The Senior and Disabled Home Rehabilitation Loan Program, which assists low-income senior

126 *https://www.aceee.org/toolkit/2020/02/bill-energy-efficiency*

127 *See Appendix C for a list of existing City of Berkeley housing protection and preservation programs.*

and disabled homeowners in repairing/modifying their homes, also presents opportunity for electrification integration. Through this action, the City would ensure these retrofits and upgrades that are funded by the City of Berkeley are opportunities to increase electrification of buildings at time of renovation.

ACTION CC-9: Leverage and Expand Existing Tenant Protection Programs to Tie Tenant Protections to Electrification Incentives to Ensure Building Upgrades Don't Result in Increased Displacement.

As funding and financing programs are developed and implemented, Berkeley expects many building owners to receive the support they need to upgrade their buildings, improve efficiency, and lower gas usage. Buildings that are currently in disrepair or in need of substantial upgrades are also the buildings that house Berkeley's LMI community members. The concern is that as these buildings are upgraded, building owners may raise rents or take other actions to displace tenants in order to recoup costs and/or increase rental income. Therefore, both existing and expanded tenant protection programs will need to be linked to these incentives to ensure that creating better buildings doesn't lead to increased displacement. All rental unit types will need to be considered. The City will continue to leverage existing efforts on tenant protections to mitigate unsafe and disruptive impacts on tenants, including Rent Board's proposed Habitability Plan Proposal and Relocation Ordinance Amendments, and to monitor laws.

ACTION CC-10: Lead City Participation in High Road Training Partnership (HRTP) Grant for High Road to Residential Building Decarbonization with Rising Sun Center for Opportunity and Other Partners.

Building on the relationships developed as part of this Strategy, the City will participate in a State-funded grant to collaborate with partners on how to advance an inclusive high road job workforce and industry for building decarbonization.

ACTION CC-11: Link Disadvantaged Berkeley Residents to Training Programs that Prepare Them to Enter and Succeed in Union Construction Careers by Supporting and Collaborating with Local MC3[128] Workforce Partners, Employers/Contractors, Berkeley Unified School District (BUSD), Peralta Community Colleges and Community Organizations to Develop and Sustain Inclusive Training Opportunities and a Long-Term Pipeline of Work in the Building Retrofit Market that Carries High Road Labor Standards.

This action strives to ensure that there are programs for training a local workforce that is eligible for high road employment in the contracting trades. This action may include pairing training with hiring by facilitating partnerships with Peralta Community College and local partnerships, creating an avenue for employment for program graduates.

ACTION CC-12: Collaborate with the Construction Trades Workforce Initiative and the Building and Construction Trades Council of Alameda County to Shape Policies and Labor Standards Leading to Inclusive, Family–Sustaining Union Construction Careers for Underrepresented Communities.

Berkeley and the State of California have a significant project ahead as buildings throughout the State likely will need to be electrified if the carbon neutrality goal established by B-55-18 is to be obtained. Homes and buildings will need new appliances, weatherization upgrades, carpentry, and electrical work completed. The City of Berkeley is committed to ensuring that underrepresented communities have equal access to the training that will unlock high road job opportunities in this field. Through collaboration with their partners, the City will participate in and help drive engagement in these communities.

128 *Multi-Craft Core Curriculum (MC3) Building Trades Curriculum pre-apprenticeship training standard set by the California Workforce Development Board. https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/10/HRCC_Building-a-Statewide-System-of-High-Road-Pre-Apprenticeship-in-California_ACCESSIBLE.pdf*

ACTION CC-13: Identify Opportunities to Advance High Road, Inclusive Union Jobs.

The City of Berkeley will work to ensure the jobs created due to the electrification of existing buildings are high road jobs through the following tools:

1. Certification, apprenticeship, or other worker skill requirements to engage a skilled and trained workforce
2. Healthcare, pension, wage standards, such as prevailing wage requirements
3. Contractor prequalification based on evidence of a skilled and trained workforce, abidance with building code and labor laws, and a history of quality workmanship; contribution to state-approved and/or Joint Apprenticeship Training Committee (JATC) apprenticeship programs
4. Best-value contracting for public and institutional buildings
5. Quality assurance and quality control processes to ensure equipment is installed, commissioned, and operating as designed
6. Regional targeted hiring requirements to ensure the participation of disadvantaged workers and/or graduates from approved MC3 pre-apprenticeship programs
7. Community workforce agreements
8. Identify public funding, such as a municipal decarbonization bond, to support large scale electrification pilot projects, such as neighborhood scale electrification in historically disinvested communities, with Labor Standards

ACTION CC-14: Support Union Contractors.

The City of Berkeley will strive to support union contractors by:

1. Aggregating projects to attract union signatories to bid and build this work
2. Creating a preferred contractors list that promotes the use of union signatory contractors for homeowners
3. Aligning city funding for municipal projects to meet the threshold for Project Labor Agreement project dollar thresholds by aggregating electrification projects to produce high quality work with high-quality jobs

ACTION CC-15: Create Robust Monitoring and Enforcement Programs to Monitor Employment Agreements and Assure High Road Jobs.

The City of Berkeley will work with its partners to monitor and enforce the programs developed to create and maintain high road jobs. Metrics and monitoring programs will be developed in conjunction with key stakeholders.

ACTION CC-16: Explore Coordinating and Partnering with Weatherization Program Providers to Support Electrification for Eligible Households.

Electrification combined with weatherization improvements provide increased efficiency and comfort benefits to res. The City should explore opportunities to partner with existing organizations that implement weatherization programs to provide education on electrification, site recommendations, and services. This idea should be further explored with the community and key stakeholders.

ACTION CC-17: Develop Incentives for Businesses that Convert to All-Electric. Prioritize Resources for Small and Longer Standing Businesses.

Many neighborhoods in the City of Berkeley contain businesses that exist in the same building or on the same block as residential units. While the focus of the strategies presented here are to facilitate the conversion of residential buildings to electric, providing incentives for businesses to convert to all-electric would help broaden the scope of areas in the City where gas pruning can be completed and build trust in the technology. These incentives would be prioritized for smaller and longer-standing businesses, to ensure that businesses who have remained as integral parts of the Berkeley community can also realize the benefits of electrification.

ACTION CC-18: Develop Public Education Campaigns and Resources to Promote New City Programs and the Benefits of Energy Efficient Systems and Appliances; Provide Information on Systems and Requirements; and Link Homeowners to a List of pre-Qualified Contractors.

Connecting the public to information and resources will be key to incentivizing existing building electrification over the short term. The City will continue to maintain and improve their website and other outreach content to reflect the most current information on contractors, rebates, incentives, and technologies.

PHASE 2–Cross Cutting Actions

ACTION CC-19: Enact a Fee on Gas Equipment with Equity Exceptions for Users. Utilize Revenue to Incentivize Electrification.

This action strives to disincentivize the purchase of gas equipment by creating a fee that makes gas equipment more expensive, encouraging consumers to opt for electric-fueled appliances and equipment. Enacting a new tax or fee would require regional coordination and collaboration to ensure effectiveness and could negatively impact equity; therefore, an income-based exemption would be built into the program. The revenue generated by this fee could then be redirected for electrification projects or to provide subsidies to low-income residents for electric equipment and retrofits.

ACTION CC-20: Develop a Comprehensive Funding/Financing Plan to Direct Electrification Investments in Marginalized Communities.

In order to achieve electrification in all buildings, a comprehensive funding and financing plan addressing how to direct these resources to marginalized communities, including LMI households, will need to be developed. The City will work with the community, as well as other experts and stakeholders across sectors to develop this plan. The comprehensive funding and financing plan will likely require a combination of on-bill financing and direct funding to be successful. Any program will need to be viewed through the equity guardrails to ensure that the program is accessible for marginalized communities and do not present the same hurdles as todays programs including upfront costs and housing deficiencies.

ACTION CC-21: Explore the Feasibility of a Bulk Purchasing Procurement Program to Acquire Appliances and Electric Panels at a Discounted Rate Through a Pilot Project.

Potential exists for establishing a bulk purchasing procurement program that would allow the City to purchase equipment needed for time of replacement and renovation electrification and then provide this equipment to the community at a cost that is discounted from retail prices. Procuring appliances and electric panels in bulk may save between 5-30 percent, reducing costs for building owners. While this cost reduction alone may not be enough to make retrofits accessible to low-income and other marginalized residents, it may provide sufficient incentive for moderate-income households and multi-family building owners.

ACTION CC-22: Collaborate with the City's Rental Housing Safety Program to Explore Opportunities to Include Electrification and Energy Efficiency Requirements in the Program. Include Accessible Funding and Financing Mechanism to Offset Marginal Cost Increases in Return for Tenant Protections.

The City of Berkeley Rental Housing Safety Program already accesses and reviews Berkeley's rental housing stock to help increase tenant safety. This action directs the City to investigate opportunities to include electrification requirements into the program as applicable once funding and financing programs are in place. For example, a building with an unsafe or non-functioning water heater or stove could make the switch to electric to improve indoor air quality and safety. In return, the building owner would receive additional support to make the transition, and the tenant would receive rent increase protections for a set period of time. As a Phase 2 measure, the actual nature of this program will be developed though collaboration across the City's departments and the community.

ACTION CC-23: Adopt a "no Reconnection to Gas" Policy as a Way to Eliminate PG&E's Obligation to Serve Gas to an All-Electric Building in the Future.

The no-reconnect policy would prevent new gas hookups from being installed in existing buildings that are all-electric. Due to the current "obligation to serve" policy, PG&E is obligated to provide gas services to anyone who wants it (see CC-25 for more information). This policy could include buildings which have previously been electrified. The no-reconnect policy would prevent any new gas hookups from being installed in existing buildings and pave the way for gas pruning in the future.

ACTION CC-24: Develop Point of New Lease and/or Rental License Electrification Requirements.

In addition to time of sale requirements, the City will also need to address electrification in rental properties which have much longer periods of time between sales and relatively shorter periods between new leases. This action directs the City to develop and include a point of new lease and/or rental license requirement for electrification. The requirements do have the potential to increase costs for building owners who, in turn, could pass those costs to renters, further exacerbating displacement within the City. Therefore, this action falls under Phase 2 and would only be enacted after accessible funding and financing programs were in place. Although there is a risk of increased costs, this action helps ensure that renters also have an opportunity to access the benefits of an electrified and efficient building.

PHASE 3–Cross Cutting Actions

ACTION CC-25: Adopt and Implement Point of New Lease and/or Rental License Electrification Requirements.

Once the point of new lease and/or rental license electrification requirements are developed and there are sufficient financing and funding opportunities available to make these upgrades affordably, the City will begin implementation during Phase 3. Implementation should be monitored throughout the process and any unforeseen impacts, especially those related to equity, should be addressed. Extensive community education and outreach will need to be conducted.

ACTION CC-26: Collaborate with Regional and State Partners to Modernize the California Public Utilities Commission's Obligation to Serve Requirement to Refer to the Need to Provide Affordable and Reliable Energy, Without Regard to the Energy Source.

As discussed in the 2020 paper by the Stanford Law School's Mills Legal Clinic, and Stanford Woods Institute for the Environment "Removing Barriers to Building Electrification":

> *"In California, section 451 of the Public Utilities Code articulates energy utilities' "obligation to serve" their customers, requiring that they "furnish and maintain . . . adequate, efficient, just, and reasonable service" for customers in their service territories. Ordinarily, utilities cannot terminate service without providing "adequate" substitute service. And this requirement also grants customers certain due process rights, including adequate notice and an opportunity to be heard prior to service termination. Legal precedent in California has not precisely outlined whether and how utilities can substitute electricity service for gas service. It also remains unclear whether the obligation to serve requires utilities to provide gas in particular, or to support the end uses (e.g., heating and cooking) that gas service enables.* [129]"

The City will collaborate with other stakeholders and partners to address this issue and advocate that the utility's "obligation to serve" can be met through providing electricity.

129 *https://law.stanford.edu/publications/removing-legal-barriers-to-building-electrification/*

ACTION CC-27: Secure Funding and Subsidies Particularly for Low-Income Property Owners and Renters to Reduce Upfront Costs of Electrification and Support Rent Stabilization to Prevent Displacement.

Renters do not have control over the upgrades made to their units–that responsibility and cost lies with the landlord. In order to electrify all buildings, including all rental units in Berkeley, actions will need to ensure that landlords, especially low-income landlords, are able to afford to make these changes that will ultimately benefit their tenants. Tenant protections would also need to be addressed for any programs with landlords.

4.3 TIME OF REPLACEMENT AND RENOVATION

Strategy Overview

The first primary policy lever for existing building electrification is Time of Replacement and Renovation, which incentivizes/requires the installation of electric equipment and appliances when fossil fueled equipment reaches the end of its useful life and/or when a major renovation is taking place. This policy's major benefit provides the lowest marginal cost of installation of electric heating/cooling systems. The marginal cost is the difference between a standard replacement and the alternative, which in this case, is all-electric. While a time of replacement and renovation policy can target fossil fuel equipment replacement at a time of least cost to building owners and operators, this will leave potential for gaps in the transition to electrification with non-permitted replacements and residences that have been recently renovated.

Phasing

Phase 1 of the time of replacement and renovation policy will strive for community engagement and education, development of incentive programs for electrification, collaboration with labor and workforce organizations to advance inclusive high road jobs, enhancement of tenant protections for communities at risk of displacement, and electrification of buildings owned and operated by the City of Berkeley. Phase 2 moves to expand the policy to require installation of electric appliances and equipment at time of replacement and renovation, which will be built upon the equity considerations of actions under Phase 1 to ensure funding and financing options are available for all residents. After several years of education and employment of Phase 1 and Phase 2 actions, the City of Berkeley will further the reach of this policy by prohibiting the installation of gas equipment in buildings as part of Phase 3.

Key Considerations

- Ability to reach all building types including rentals and commercial buildings.
- Focus initially on HVAC and hot water heaters
- Lowest marginal costs but incomplete electrification (some remaining gas uses) means more gas infrastructure will need to remain in use.
- Clear need for accessible funding and financing solutions to lower/remove upfront costs prior to mandatory requirements.

STRATEGY 1–
TIME OF REPLACEMENT AND RENOVATION

Access to Health & Safety Benefits

Opportunities

- Time of Replacement and Renovation requirements affect all buildings, including rentals.
- Time of Replacement and Renovation retrofits have practical efficiencies by leveraging work being done, as well as cost efficiencies because the marginal cost to electrify is lower than the full cost.
- Housing upgrades will benefit marginalized communities who have worse health impacts due to substandard housing and climate change impacts.
- Air space heat pumps with good air filtration and envelope improvements can help increase comfort and safety in high heat events and poor air quality days.
- Solar + storage added to electrification provides resilient backup power during grid outages which is particularly important for seniors and people with disabilities.

Risks

- Electrifying buildings in a piecemeal approach does not achieve the same lifecycle savings as doing a complete electrification retrofit (due to potential for stranded gas infrastructure).
- Gas rates are predicted to increase over time, disproportionately affecting those unable to electrify today.
- Electricity rates are also anticipated to increase, and there is uncertainty around the future.
- Potential for reduced permit compliance to avoid requirements.

Potential Solutions

- Development of accessible Tariffed On-Bill Financing can help address upfront costs (CC-7, TORR-5).
- Tie electrification into new and existing programs for building rehabilitation (CC-8, CC-22).
- Conduct affordable housing pilot projects and expand based on the results (TORR-4).

Access to Economic Benefits

Opportunities

- Potential bill savings, avoiding future high gas costs.
- Accessible programs like tariffed on-bill financing can provide opportunities for those who cannot take on more debt.
- Marginal cost of electrifying at Time of Replacement and Renovation is lower than full cost.
- Incentives can be targeted toward specific technologies and households who need it most (CARES)*.
- Opportunity to advance high road jobs with labor standards and other tools.

Risks

- Out of reach for many community members, especially those in historically marginalized/impacted groups.
- Potential for creating low wage jobs if high road job standards are not put in place.
- Potential for increased bills if using low efficiency equipment, no solar, or time-of-use rates without battery storage.

Potential Solutions

- Collaborate with labor and workforce partners to advance high road job opportunities (CC-10 through CC-15).
- Provide accessible funding/financing programs (TORR-5, CC-19, CC-20).
- Work with partners to develop incentives (CC-9, TORR-1, TORR-3).

*–California Alternate Rates for Energy Program (CARE) is a discount energy rate program for eligible customers that provides a discount of 20% or more on gas and electricity rates. Participants qualify through income guidelines or if enrolled in certain public assistance programs.

STRATEGY 1 (CONTINUED)– TIME OF REPLACEMENT AND RENOVATION

Maximize Ease of Installation

Opportunities

- Incentives can be targeted toward specific technologies and households who need it most (CARES).

Risks

- Incentives can traditionally be difficult to access for low-income communities.
- Construction time may be required (moving appliances, panel upgrades, wiring).
- Risk of short-term displacement which can be harmful to many, especially the disability community.

Potential Solutions

- Integrate with existing building rehabilitation programs (CC-8, CC-22).
- Tie permits to incentives (TORR-3).
- Ensure tenant protections for adequate, appropriate, accessible, housing security during renovations, especially for people with disabilities (TORR-6).

Promote Housing Affordability & Anti-Displacement

Opportunities

- Potential to reduce energy burden for people struggling to pay energy bills.
- Potential to pilot anti-displacement protections.

Risks

- Potential for gentrification and displacement, including through loss of unregulated affordable housing, without adequate protections due to upgraded building stock and pass-through costs.
- Potential for bill increases without the use of high efficiency appliances.

Potential Solutions

- Tie tenant protections to subsidies/incentives for electrification (CC-9).
- Conduct electrification pilot of affordable housing with bill reduction/displacement guarantees and expand the program based on results (TORR-4).

PHASE 1–Time of Replacement and Renovation Actions

ACTION TR-1: Develop Programs and Incentives to Target Specific End Uses, such as HVAC and Hot Water Systems

Encouraging the Berkeley community to voluntarily adopt electrification will require financial incentives to purchase electric equipment, as well as a program to market and share their availability. This approach can be targeted to high gas use equipment, such as HVAC and hot water heaters, to provide the most effective reduction in fossil fuel consumption. Without dedicated funding for electrification upgrades, there is potential for lower income households/renters missing out on electrification benefits and for increased rent to offset the upfront cost.

Action TR-1 serves as a Phase 1 action which acts to improve the ability for home and building owners/operators to access the benefits of electrification by reducing the upfront costs of equipment. Including the incentives as part of a larger program which brings more information on the benefits of electrification can help to engage the community and further promote the City of Berkeley's electrification efforts. This action develops the foundational need for funding mechanisms and education through a voluntary program before implementation of mandatory Phase 2 and Phase 3 actions.

ACTION TR-2: Provide Culturally-Sensitive Education to the Community on Benefits of Electrification at Time of Replacement and Signal Long-Term Phase Out of Gas by 2045.

The City of Berkeley has set aggressive targets for the complete phase out of gas and reaching the targets will require action on the side of both the City and community. Community engagement and buy-in will be an essential component of the time of replacement and renovation policy, as community members will need to understand the benefits and impetus of voluntary building electrification. An education campaign that focuses on time of replacement and renovation electrification will need to be coordinated with the development of incentive programs in order to highlight the potential to address the upfront cost barriers of electric equipment.

Action TR-2 is foundational to the success of the time of replacement and renovation policy by providing education to encourage community members to transition away from fossil fuels and prepare for later mandatory Phase 2 and Phase 3 actions.

ACTION TR-3: Work with Partners like EBCE, BayREN, PG&E and Others to Tie Incentives for Purchasing Heat Pump Water Heaters and HVAC Units to Electric Heat Pump Permits to Allow for Direct Installations, Especially for LMI Homes.

One of the major hurdles many community members face is lack of knowledge regarding incentives and rebates for electric equipment. When an appliance like a hot water heater breaks, there is rarely time to conduct extensive research on the programs available. This action would tie these resources directly to the permit for the appliance. When a permit is pulled for a heat pump hot water heater, that incentive would be given directly to the installer. This would lower the upfront costs for consumers and further incentivize electrification. Furthermore, this action would help remove the procedural inequities currently experienced by marginalized communities who may not have the time to conduct research or resources to pay the full price of the equipment while they wait for rebates to arrive.

ACTION TR-4: Conduct Electrification Retrofit Pilot with Either Deed Restricted Income Qualified Housing or Naturally Occurring Low Income Housing with Antidisplacement Tenant Protections.

Through implementation of pilot projects, the City can gain firsthand experience in the technical considerations for building electrification, providing opportunity to develop best practices to enable future electrification. This action also provides opportunity for the City to be a leader in electrification, paving the way for the rest of the community. Furthermore, while the City does not own affordable housing in the City, it does fund affordable housing. These locations will be prioritized for investment and electrification with guarantees for tenants on energy bills and housing security.

A project of this type would help the City of Berkeley develop best practices that can be communicated with residents and private building owners and operators, as well as inform future electrification retrofit projects performed by the City. Bill reductions, tenant support, and anti-displacement guarantees would be necessary during and after project completion to ensure this action does not negatively impact residents. This pilot would be funded by the City of Berkeley and act as a first step towards wider electrification in the City. This project would need to be designed in collaboration with the residents, owners, and community.

ACTION TR-5: Work with Partners like EBCE, PG&E, BAAQMD and Others to Begin Developing an Accessible Funding/Financing Strategy for Replacement of Appliances, like Accessible Tariffed On-Bill Financing, to Support Widespread Electrification.

One of the most critical goals of Phase 1 implementation is to identify and ensure accessible funding resources are available to support widespread electrification. This action serves to establish partnerships for making funding and financing for the replacement of fossil fueled equipment with electric equipment. Tariffed on-bill financing (TOBF) is one mechanism that can be implemented through partnership with EBCE and PG&E. TOBF would allow energy customers to finance electrification retrofits by using their energy bill as the repayment vehicle, reducing the upfront costs of electric equipment at time of replacement and renovation. On-bill financing is also a key equity strategy as it provides a source of financing that is decoupled from personal finances like credit scores and tied to the equipment and the property rather than the person. The City should consider a disclosure requirement for existing tenants prior to any tariffed on-bill financing agreements and in leases for prospective tenants if there is existing tariffed on-bill financing. The unlocking of TOBF and other funding strategies through partnership with utility providers and BAAQMD are an essential component of the time of replacement policy by making electrification affordable and cost effective for Berkeley residents.

ACTION TR-6: Develop Policies to Enhance Tenant Protections for Adequate, Appropriate, Accessible Housing Security During Renovations Especially for Those with Disabilities.

The protection of affordable housing for LMI residents was identified as a core concern of the community and is a high priority in the implementation of electrification policies. Specifically, with time of renovation strategies, there is increased risk of tenants needing to temporarily vacate residences during renovations, especially if tenants rely on home equipment for their health or mobility. This action would include the development of policies to ensure that temporary housing during renovation is adequate for the tenants' needs and that extended renovations are not used to cause permanent displacement. For example, residents with disabilities may need special accommodations that must be considered when accommodations are arranged for tenants who are temporarily vacating their homes during renovations.

ACTION TR-7: Develop Program to Educate Community on Economic Benefits of Upgrading HVAC and AC to a Single Heat Pump Unit at Time of Replacement. Consider Requiring All New AC Installations to Be Heating and Cooling Heat Pumps.

A benefit of the conversion to electric heat pumps for space heating is that they can provide air conditioning as well as heating. Communicating this fact to building owners may help with heat pump adoption at time of replacement and renovation as it is a significant opportunity for cost savings in buildings that already have AC units near their end of life and for building owners that are considering installation of AC capabilities. This conversion can also provide improved comfort. As noted in Chapter 3, installing a heat pump HVAC system will likely be less expensive than installing a new central furnace and air conditioner. Including information about the potential for a warming climate and more extreme heat days may also help incentivize building owners to install electric heat pumps for the purpose of adding AC to residences.

ACTION TR-8: Allow Setback Exemptions for Heat Pump Condensing Units and Conduct a Study of Heat Pump Noise Levels to Exempt any Models that Fall Under Noise Thresholds to Streamline Installation.

Air source heat pumps used for space heating and cooling require installation of a condensing unit outside of the building, which may need to be placed in an area that exceeds building setbacks allowed by the current City of Berkeley zoning code. This action would allow for exemption of units that could increase the potential for buildings that are able to install heat pumps at time of replacement and renovation. Additionally, the City also has a noise ordinance that requires a noise study for many new construction projects including the installation of HVAC condensing units. This action directs the City to conduct a noise study of top heat pump HVAC units and exempt units that fall under the noise thresholds. This would streamline installation of qualified heat pumps, furthering the potential reach of the time of replacement and renovation strategy.

ACTION TR-9: Adopt a Time of Replacement Electrification Policy for All Municipal Buildings.

A time of replacement electrification policy would provide the City of Berkeley with a mechanism to ensure that all future replacements of gas fueled equipment at municipal buildings are converted to electric over time. This action would provide a cost effective means for the electrification of municipal buildings, as well as demonstrate the City's commitment to building electrification and leading by example.

ACTION TR-10: Explore Simplifying Heat Pump Hot Water Heater Permits Where Possible so that Only an Electric Permit is Required, as Opposed to Both Plumbing and Electrical Permits.

The City will explore streamlining and simplifying the permitting process which could enhance the permit compliance rate and incentivize more electrification projects. By only requiring an electric permit for heat pump hot water heater installation, instead of the electric and plumbing permits that are currently required, the requirements for installing a heat pump would be reduced. This should translate to less expensive and faster installs which is critical when replacing failed equipment like an emergency hot water heater replacement.

PHASE 2–Time of Retrofit and Renovation Actions

ACTION TR-11: Implement a Time of Replacement Requirement for HVAC and Hot Water Heaters Once an Accessible Funding/Financing Option is Available.

To further the Phase 1 voluntary electrification at time of replacement, this action would make it mandatory to replace fossil fueled equipment with electric heat pumps. This action would be implemented by only approving permits for electric equipment. Mandatory measures for replacement would only be implemented after adequate and accessible funding/financing options are available to all building owners. Implementation will require updating of permit collection requirements and a significant effort to improve permitting compliance rates. Additional actions under the time of sale strategy would supplement this action by reaching buildings where equipment is replaced without going through the permitting process. As a Phase 2 action, this would only be implemented after extensive community collaboration and when accessible funding and financing options are available.

ACTION TR-12: Implement a Mandatory Time of Renovation Upgrade Program that Provides a Menu of Upgrade Options Relating to Electrification and Efficiency During Building Renovation.

Requiring electrification through a time of renovation program would further the efforts for voluntary electrification actions. This action is tied to existing statewide Title 24 building requirements and would fit into the City's existing permitting process to require electrification when certain building renovations are carried out. The City would provide a selection of electrification and efficiency upgrade options, which would clearly demonstrate prescriptive and/or performance methods for achieving compliance. Implementation will require updating of permit collection requirements and a significant effort to improve permitting compliance rates. As a Phase 2 action, this would only be implemented after collaborating with the community and when accessible funding and financing options are available.

ACTION TR-13: Adopt a Reach Code for Substantial Renovation or Other Electrification Requirements at Time of Building Permit.

This action directs the City to adopt an ordinance that would require all new building renovations to comply with Berkeley's new construction electrification requirements. This would be an extension of TR-12 but would now require all retrofits over a cost or square foot threshold to electrify effected appliances. Conducting upgrades at time of retrofit will lower overall costs associated with construction by combining electrification work with the overall retrofit process. As a Phase 3 action, this ordinance would only be put in place once accessible funding and financing is available to help cover the upfront costs of electrification if a cost differential between gas and electric appliances still exist at time of implementation. As a Phase 2 action, this would only be implemented after collaborating with the community and when accessible funding and financing options are available.

PHASE 3–Time of Replacement and Renovation Actions

ACTION TR-14: Prohibit Installation of Gas Equipment and or Permitting of any NO_x Emitting Appliances.

BAAQMD regulations could ban the sale of nitrogen oxide (NO_x)-emitting appliances (those that use gas) within the Bay Area. To ensure effectiveness, this strategy would need to be implemented concurrently with a ban on installation of gas appliances. There is also potential that the City of Berkeley could take this action itself. Cal Health & Safety Code §§ 39002 & 39037 operates as a general background principle for how stationary source air pollution regulation operates across the State. In general, "the governing body of any city, county, or district" has "the primary responsibility for control of air pollution from all sources other than vehicular sources." This language suggests that cities, counties, and air districts can set standards on stationary sources. The City will explore these options, and as this is a Phase 3 action, this ordinance will only be implemented after collaborating with the community and when accessible funding and financing options are available.

4.4 TIME OF SALE

Policy Overview

The time of sale policy builds on Berkeley's successful Building Emissions Saving Ordinance (BESO) to identify opportunities for electrification when a building is being sold. The City understands that buying a home in the City of Berkeley is already difficult with a median home price of approximately $1.5 million as of 2021. However, the opportunity to include home upgrades in a mortgage is one of the key opportunities for cost effective retrofitting an existing building to be all electric. As noted in Chapter 3.0, modeling found that over 50 percent of homeowners could see positive cash flows from day one by financing the incremental cost of the electrification package. However, due to the high cost of most Berkeley buildings, many sales are considered "jumbo loans" with no green financing products available to complete this

type of work, and more work will be needed to help develop financing products that meet the needs of homebuyers and sellers in the City.

Therefore, the City has focused primarily on voluntary measures, education, and building the correct financing tools needed to enact a more robust Time of Sale strategy over time.

Phasing

Phase1 of the time of sale policy will include education to new home buyers as well as rebates and incentives to begin electrifying buildings over the short term. In addition, the BESO program will begin the process of developing mandatory energy upgrade requirements to be phased in over time. The City will also work with State, local, and even federal partners to identify green mortgages appropriate for Berkeley's housing market. During Phase 2, the City will begin a permit compliance check at time of sale in order to ensure that time of replacement policies are being followed and to begin the implementation of mandatory time of sale requirements. Finally, during Phase 3, the City will further expand the time of sale policy to include the electrification of equipment nearing or past the end of its useful life.

Key Considerations

- Access to high quality and low cost financing vehicles (e.g., mortgage, refinancing).
- BESO program already well-established.
- Potential equity impacts due to high housing costs (see Equity Guardrail Analysis below).
- People purchasing homes in this current market are in the high wealth and/or high income brackets and tends to exclude frontline community members who have been negatively impacted by structural racism.

STRATEGY 2–TIME OF SALE

Access to Health & Safety Benefits

Opportunities

- Provides opportunities to upgrade homes when changing ownership, which can be a convenient time for making upgrades.

Risks

- Time of sale does not impact most rental properties which have low turnover rates.

Potential Solutions

- Target rental properties primarily through other strategies.
- Collaborate with the City's Rental Housing Safety Program to explore opportunities to include electrification and energy efficiency requirements in the program. Include accessible funding and financing mechanism to offset marginal cost increases in return for tenant protections (CC-22).
- Implement point of new lease/ or rental agreement electrification requirements (CC-25).
- Develop accessible funding and financing options such as mortgages and refinancing options (TS-2).

Access to Economic Benefits

Opportunities

- Opportunity to advance high road jobs with labor standards and other tools.
- Opportunity to tie upgrades to mortgage.
- Opportunity to advance accessible financing and funding options such as mortgages and refinancing that could provide a low interest rate financing mechanism for electrification.

Risks

- Home prices in Berkeley may be too high for existing mortgage and/or other financing options.
- Potential for creating low wage jobs if high road job standards are not put in place.
- Expensive housing market means many home buyers are already stretched thin financially.

Potential Solutions

- Work to identify accessible financing and funding options such as mortgages and refinancing options that work in Berkeley's housing market (TS-2).
- Work with local partners to provide training and encourage high road job development (CC-10 – CC-15).

Maximize Ease of Installation

Opportunities

- Time of Sale requirements under BESO will be developed and could include electrification upgrades.

Risks

- Time of Sale can add additional costs or procedural burdens in an already expensive housing market.

Potential Solutions

- Tie permit compliance review to existing BESO requirements (TS-4).
- Begin Time of Sale requirements with voluntary policies like incentives for electrification work (TS-1).
- Collaborate with the City's Rental Housing Safety Program to explore opportunities to include electrification and energy efficiency requirements in the program. Include accessible funding and financing mechanism to offset marginal cost increases in return for tenant protections (CC-21).

Promote Housing Affordability & Anti-Displacement

Opportunities

- Upgraded buildings could lower energy bills and operating costs for tenants.
- Time of Sale represents an opportunity to do building work without displacing residents/occupants.

Risks

- Potential for increased rents and displacement for renters if/when Time of Rental License/ Lease Requirements are implemented.

Potential Solutions

- Include accessible funding and financing mechanisms to offset marginal cost increases in return for tenant protections (TS-6).

PHASE 1–Time of Sale Actions

ACTION TS-1: Consider Incentive Programs that Would Accelerate Retrofits on Residential Properties, Which Could Include Electrification Upgrades at Time of Sale.

The City could explore developing incentive programs targeted at low-income and/or first-time home buyers.

ACTION TS-2: Collaborate with Private and Public Partners to Develop and Provide Accessible Financing and Funding Programs for Homeowners such as Mortgages and Refinancing Options.

There are several green mortgage or energy efficiency mortgages available today. However, due to the rather unique makeup of Berkeley's housing market (high cost and fast sale times), it may be difficult to apply one of these mortgages in practice. Many mortgages require an HERS energy efficiency rating to determine the amount of savings available but also allow borrowers to increase the size of the loan for energy efficiency upgrades without needing to qualify for the larger loan. This allows home buyers to finance their upgrades over time and, as noted in Chapter 3.0, see positive cash flows. However, many of these loans are not available for jumbo loans or home loans over a certain price. Due to Berkeley's current high demand housing market, many of the homes now require these jumbo loans. More work needs to be done to streamline this process and develop accessible financing and funding programs for homeowners that work within the City of Berkeley. This action directs the City to work with local lenders, the State, and other stakeholders to promote new and innovative financing and funding packages like mortgages and refinancing options to promote electrification.

ACTION TS-3: Develop Mandatory Time of Sale Energy Upgrade Requirements for BESO.

During Phase 1, the City will begin developing mandatory time of sale energy upgrade requirements for the BESO program. These time of sale requirements could include panel upgrades or wiring for new appliances, air sealing and other weatherization, or minimum appliance efficiencies.

PHASE 2–Time of Sale Actions

ACTION TS-4: Include a Permit Compliance Review in the BESO Program to Ensure Appliances Were Replaced According to Electrification Requirements.

One of the major issues affecting a time of replacement ordinance is a lack of permit compliance. In order to sidestep new time of replacement requirements, some homeowners may opt to have work done without a permit, decreasing the effectiveness of the ordinance and causing negative impacts to safety and building stock quality. To remedy this, the City will conduct a permit compliance check at time of sale. During the BESO review, inspectors will identify any recent equipment replacements and ensure that all work has been performed under a valid permit. Fines will be levied against non-conforming properties, and the fees will be used to fund the inspection program and, potentially, incentivize electrification.

ACTION TS-5: Adopt and Implement Mandatory Time of Sale Energy Upgrade Requirements for BESO Developed in TS-3, When Accessible Funding and Financing is Available.

Once the mandatory time of sale requirements for BESO are developed, and there are sufficient financing and funding opportunities available to make these upgrades affordably, the City will begin implementation during Phase 2. Implementation should be monitored throughout the process and any unforeseen impacts, especially those related to equity, should be addressed.

4.5 BUILDING PERFORMANCE STANDARDS

Strategy Overview

A building performance standard sets a minimum level of performance that buildings must achieve by set target dates. Performance standards can be set by requiring a minimal level of energy use (efficiency) or GHG emissions per square footage of building or require an overall GHG emissions reduction established from a building's baseline or elimination of fossil fuels by a set date. This strategy will likely only effect commercial and multi-family buildings of 15,000 square feet or larger. The building performance standards would build on the City's existing BESO program and AB 802 which requires large building owners to report the electricity and gas use of their buildings.[130] The building performance requirements would move past requiring only an energy disclosure to require electrification upgrades to buildings to meet performance standards by specific dates. Building owners would need to either improve their buildings or may be required to pay fees for under-performing buildings. Funds may also be needed to assist low- and medium-income properties to electrify.

Phasing

Phase 1 of the building performance standard would focus on the development of the standard, including whether an energy efficiency or GHG emission standard would be used and what threshold for performance should be set. Phase 1 also includes the development of exemptions, funding and financing support, compliance assistance tools, and other support for building owners. Phase II moves to implement the policies developed as part of Phase 1. As the program is implemented, the thresholds will be tightened. In Phase 3, additional policy measures to encourage and support non-compliant buildings will be considered, such as fees and subsidies, as well as expanding the performance standards to other buildings.

130 *https://www.cityofberkeley.info/benchmarking_buildings/*

Key Considerations

- Focuses on some of Berkeley's largest energy-consuming buildings.
- Give large building owners time to prepare by phasing in performance standards over time.
- Do not want increased energy costs for tenants.

STRATEGY 3–BUILDING PERFORMANCE STANDARDS

Access to Health & Safety Benefits

Opportunities

- Future building performance standards would affect larger buildings over 25,000 square feet (with the future potential to affect buildings under 25,000 square feet).

Risks

- Some building/workplaces do not have capital to invest in improved equipment, efficiency, electrification.

Potential Solutions

- Develop requirements for building performance standards for Berkeley's large existing buildings (25,000 square feet and over) that lead to the elimination of fossil fuel use, as per 2020 BESO amendment (BP-1).
- Expand the existing BESO building performance standards (BP-1) requirement for multifamily and commercial buildings to include buildings under 25,000 square feet. (BP-3).
- Develop interim requirements for asset management and capital plans to schedule investments in the future.

Access to Economic Benefits

Opportunities

- Building performance standards provide a wide range of options for building upgrades.
- Additional opportunities for high road job generation.

Risks

- The cost of building upgrades could raise rents and disproportionately affect low income tenants.

Potential Solutions

- Develop tools, funding and financing to assist buildings with meeting building performance standard requirements developed as per 2020 BESO amendment, with extra support and tenant protections for LMI residents (BP-4).
- Consider applying fees associated with GHG emissions to accelerate elimination of gas, with tenant protections, and apply revenues to electrify LMI multifamily buildings (BP-5).

Maximize Ease of Installation

Opportunities

- Performance standards and benchmarking provides an opportunity to interface with owners of low-performing buildings and provide supports.

Risks

- Increased burden for building owners and tenants who may not know best technologies, rebates, and incentives.

Potential Solutions

- Develop tools, funding and financing to assist buildings with meeting building performance standard requirements developed as per 2020 BESO amendment, with extra support and tenant protections for LMI residents. (BP-4).

Promote Housing Affordability & Anti-Displacement

Opportunities

- Upgraded buildings may have lower energy bills and operating costs.

Risks

- Upgraded buildings may cause increased rents and displacement.

Potential Solutions

- Develop tools, funding and financing to assist buildings with meeting building performance standard requirements developed as per 2020 BESO amendment, with extra support and tenant protections for LMI residents (BP-4).
- Consider applying fees associated with GHG emissions to accelerate elimination of gas, with tenant protections, and apply revenues to electrify LMI multifamily buildings (BP-5).
- Leverage and expand existing tenant protection programs to tie tenant protections to electrification incentives to ensure building upgrades don't result in increased displacement (CC-9).

PHASE 1–Building Performance Standard Actions

ACTION BP-1: Develop Requirements for Building Performance Standards for Berkeley's Large Existing Buildings (25,000 Square Feet and Over) that Lead to the Elimination of Fossil Fuel Use, as Per 2020 BESO Amendment.

This Phase 1 action will be the basis for the building performance standard program. As part of the development of the program, Berkeley will need to define the performance metric (energy efficiency, GHG emissions or use of fossil fuels), the minimum performance levels over time to send clear signals to building owners, and provide sufficient time to align with capital planning. The City will also need to define the timeline for including additional building sizes. The building performance standard will ensure that Berkeley's commercial, multi-family and mixed use buildings will perform efficiently into the future.

PHASE 2–Building Performance Standard Actions

ACTION BP-2: Adopt and Implement Performance Requirements for Buildings Developed as Part of BP-1.

Once the covered building types, exemptions, and performance standards are developed, the City will begin implementation during Phase 2. Implementation should be monitored throughout the process and any unforeseen impacts, especially those related to equity, should be addressed, such as impacts on small businesses and LMI tenants. Additional resources and policies may need to be developed over time as the performance standards become more stringent and cover more buildings.

ACTION BP-3: Expand the Existing BESO Building Performance Standards (BP-1) Requirement for Multi-Family and Commercial Buildings to Include Buildings Under 25,000 Square Feet.

As the program is implemented, the City will expand to include smaller buildings. Expansion of the BESO building performance standards will bring more buildings into the program and reduce GHG emissions within the City. However, care will need to be taken to ensure equitable implementation of the program including management of cost pass-through to tenants and to ensure building owners do not remove amenities to reduce energy consumption (i.e., on-site laundry).

ACTION BP-4: Develop Tools, Funding, and Financing to Assist Buildings with Meeting Building Performance Standard Requirements Developed as Per 2020 BESO Amendment, with Extra Support and Tenant Protections for LMI Residents and Small Businesses.

To help support building owners whose buildings do not meet the current building performance thresholds, the City of Berkeley will develop a suite of compliance assistance tools including incentives, technical assistance on cost effective approaches, and best practices. This information will be provided to the owners of buildings that are currently in the program as well as those who will be phased in over time.

While increasing the efficiency of Berkeley's worst performing buildings through the building performance standard will likely decrease operating costs and save tenants money on energy bills, there will most likely be upfront costs associated with these upgrades. In addition, building owners may charge more rent for upgraded buildings which could result in increased displacement. To help remedy these potential negative impacts, the City will work to develop exemptions, funding, and financing options, as well as tenant protections to help support Berkeley's LMI renters. One potential source of funding would be fees generated as part of the building performance standard itself, paid for by buildings that do not meet the identified performance thresholds.

PHASE 3–Building Performance Standard Actions

ACTION BP-5: Consider Applying Fees Associated with GHG Emissions to Accelerate Elimination of Gas and Apply Revenues to Electrify LMI Multi-Family Buildings, While Providing Tenant Protections.

The performance metric should become more stringent over time at set intervals to allow building owners to plan their long term strategies. By 2045 the GHG emissions should be set to zero to allow for the achievement of Berkeley's long-term carbon neutrality target.

4.6 NEIGHBORHOOD ELECTRIFICATION AND GAS PRUNING

Strategy Overview

The neighborhood electrification and gas pruning policy identifies ways that neighborhood-level electrification projects can be completed and gas infrastructure can be strategically eliminated from the City of Berkeley. This policy and supporting actions differ significantly from the other policies as it seeks to gain significant overall cost savings and efficiencies by electrifying entire neighborhoods rather than individual appliances. This approach holds the most promise for reaching the fossil fuel free goals at a large scale community level and includes elimination of gas within buildings and the pruning of the gas distribution system that runs beneath the streets and leaks methane, a potent greenhouse gas 86 times worse than carbon.

Working at the neighborhood scale builds community resiliency and promotes equity rather than a piecemeal, building-by-building approach. For example, if most people on a block electrify but a few do not, the entire block will still need to be served by gas infrastructure, and those left behind will pay higher gas prices. This is also an opportunity to encourage community-scale projects with labor standards and workforce agreements that can advance high road jobs.

While neighborhood electrification can take place without gas pruning, planned decommissioning gas distribution lines offers important benefits including reducing outdoor methane emissions, eliminating investments

in stranded asset, aggregated neighborhood electrification and strategic workforce transition for gas workers. Implementation of this strategy would require regulatory changes at the CPUC to allow for utilities to have more flexibility in reallocating funding from the repair or placement of gas lines to electrification projects. Neighborhood-scale electrification projects would also require complete community buy-in and adequate tenant protections to reduce the potential for displacement during and after electrification projects. This strategy would also help ensure an equitable transition from fossil fuels by working to electrify all the buildings in a neighborhood, thereby reducing the potential for leaving lower income households stranded with higher gas rates. Gas pruning would also decrease the amount of stranded gas assets and help mitigate the expected gas rate increases.

Phasing

Phase 1 of the neighborhood electrification and gas pruning policy will strive to remove regulatory barriers that prohibit utilities from shifting investment in gas infrastructure to electrification project, identifying funding for neighborhood electrification pilot projects, community outreach and education, and enhancement of tenant protections for communities at risk of displacement. After overcoming the hurdles of Phase 1, the City will implement Phase 2 actions, which includes the implementation of a neighborhood-scale beneficial electrification projects and gas pruning, development of carbon and fossil fuel fees/taxes to disincentivize use of fossil fuels, electrification incentives for small businesses, and strategic planning for further gas infrastructure pruning.

Key Considerations

- Current CPUC regulations must be addressed to successfully implement neighborhood electrification and gas pruning.
- Gas pruning may have high upfront cost of neighborhood level electrification projects.
- Locations for gas pruning must meet technical, financial, equity and community considerations.
- Neighborhood level electrification requires participation from all property owners and residents.

STRATEGY 4–NEIGHBORHOOD ELECTRIFICATION AND GAS PRUNING

Access to Health and Safety Benefits

Opportunities

- Neighborhood scale electrification would ensure all buildings within a neighborhood are electrified and receive the related benefits.
- When buildings are electrified in a piecemeal manner, this can cause instabilities in the gas infrastructure system which is pressure-based. By taking a holistic approach to entire sections of the gas infrastructure, this can be a more stable approach.

Risks

- Focus could be put on more affluent neighborhoods due to less financial difficulties.
- This approach requires participation from all residents, who have different needs and priorities, which will require time and resources to ensure equitable access.

Potential Solutions

- Explore public funding mechanisms (e.g. a municipal decarbonization bond or carbon fee), to support large scale electrification pilot projects, such as neighborhood scale electrification in historically disinvested communities, with inclusive high road union jobs and workforce development in partnership with organized labor (NE-1).
- Conduct a neighborhood beneficial electrification with infrastructure pruning pilot project in coordination with PG&E within the City of Berkeley, with a focus on marginalized communities (NE-4).
- Collaborate with community organizations to provide culturally-sensitive educational resources to support outreach and engagement (CC-6).

Access to Economic Benefits

Opportunities

- Opportunity for a larger scale of high road job opportunities related to Neighborhood Electrification to meet the need of larger-scale projects.
- Potential on-bill savings due to electrification.
- Gas pruning could be a source of funding/financing for electrification projects.
- By bringing an entire neighborhood to become all-electric, does not “leave behind” some on gas with higher gas prices.

Risks

- High upfront costs associated with electrification.
- Current policy hurdles prevent reallocation of costs from gas to electric infrastructure.
- Potential burden to small business.

Potential Solutions

- Explore public funding mechanisms, to support large scale electrification pilot projects, such as neighborhood scale electrification in historically disinvested communities, with inclusive high road union jobs and workforce development in partnership with organized labor (NE-1).
- Develop a pilot project funding plan that allows flexible accounting to allow PG&E to demonstrate potential solutions to current regulatory financial barriers (such as gas vs. electrical assets, capital vs. expense accounting) (NE-2).
- Develop a comprehensive funding/financing plan to direct electrification investments in marginalized communities (CC-20).
- Collaborate with labor and workforce partners to advance high road job opportunities (CC-10-15).

STRATEGY 4 (CONTINUED)–NEIGHBORHOOD ELECTRIFICATION AND GAS PRUNING

Maximize Ease of Installation

Opportunities

- Neighborhood scale electrification and gas pruning opens up opportunities for bulk purchasing.
- Neighborhood scale electrification would be a good fit for union and other high road jobs.

Risks

- Current regulatory hurdles prevent reallocation of infrastructure funds.
- Different building owners/tenants will have different appliance needs.
- Short term impacts due to construction in homes/buildings.

Potential Solutions

- Ensure tenant protections for housing security during retrofits (CC-9).
- Collaborate with regional and State partners to update regulations (CC-26).

Promote Housing Affordability & Anti-Displacement

Opportunities

- Cost effective upgrades at the neighborhood scale.
- Inclusion of all homes/rental units/businesses.

Risks

- Increased housing costs/rents due to upgrades.
- Impacts to small businesses.

Potential Solutions

- Collaborate with labor and workforce partners to advance high road job opportunities (CC-10-15).
- Tie retrofit funding and financing packages to non-displacement requirements (NE-3).
- Develop incentives for businesses that convert to all-electric. Prioritize resources for small and longer standing businesses. (CC-17).

PHASE 1–Neighborhood Electrification and Gas Pruning Actions

ACTION NE-1: Explore Public Funding Mechanisms (e.g., a Municipal Decarbonization Bond or Carbon Fee), and/or Grants to Support Large Scale Electrification Pilot Projects, such as Neighborhood Scale Electrification in Historically Disinvested Communities, with Inclusive High Road Union Jobs and Workforce Development in Partnership with Organized Labor.

The City will work to identify public funding including grants from the State and federal level to conduct neighborhood scale electrification projects with a priority in Berkeley's historically disinvested neighborhoods. Conducting neighborhood scale electrification opens the potential for partnerships with organized labor, bulk purchasing, and other economies of scale. Creating projects of this size and magnitude will need to leverage extensive outreach, communication, and trust in the City and the technologies employed, all of which will be developed through other actions identified in this Strategy.

ACTION NE-2: Develop a Pilot Project Funding Plan that Allows Flexible Accounting to Allow PG&E to Demonstrate Potential Solutions to Current Regulatory Financial Barriers (such as Gas vs. Electrical Assets, Capital vs. Expense Accounting).

Current utility accounting standards separate between capital dollars and expense dollars and do not allow re-budgeting or re-allocation of these dollars within a 3-year General Rate Case window. These constraints prevent PG&E from redirecting funds for gas projects to investments in electrification, which would typically be considered expense projects. A pilot project funding plan would allow for exploration of this shift in accounting practices and provide best practices for unlocking funds currently used for gas projects to be reallocated to electrification projects.

ACTION NE-3: Tie Retrofit Funding and Financing Packages Related to Neighborhood Electrification and Gas Infrastructure Pruning to Non-Displacement Requirements.

The upfront costs required for electrification retrofits and the resulting higher quality housing generates concern over the potential for displacement of tenants. Building owners who receive funding from infrastructure pruning to upgrade buildings may then see opportunity to raise rents, increasing displacement. This action serves to create displacement protections by tying non-displacement requirements to retrofit funding and financing packages. This would prohibit property owners from displacing tenants or passing through electrification retrofits costs to increase rents.

ACTION NE-4: Conduct a Neighborhood Electrification and Gas Pruning Pilot with Transparent Community Engagement.

This action includes the planning and completion of a neighborhood electrification and gas pruning pilot project. Even without the ability to divert monies from gas infrastructure upgrades, a proof of concept project would help support the potential for infrastructure pruning in Berkeley and throughout California. A project of this type also provides opportunity to benefit marginalized communities by providing safe and comfortable housing with lowered energy bills. The funding, technical, and equity aspects of the pilot project could be used to develop best practices and inform future neighborhood electrification and gas pruning projects statewide.

PHASE 2–Neighborhood Electrification and Gas Pruning Actions

ACTION NE-5: Work with PG&E to Develop a Comprehensive Strategy to Guide Gas Infrastructure Pruning and Update Based on Changes to Foundational Issues Identified in Phase 1.

This action would draw on three mechanisms to promote infrastructure pruning.

1. Where appropriate, remove an entire segment of the pipeline.
2. "Extended release": set a target of transitioning a particular segment over 10 years, to allow for electrification upon replacement.
3. Reduce demand in a service territory until transmission line pressure drops to the point it can be downrated to a distribution line, which would be less costly to maintain.

These mechanisms would be further expanded upon based on the regulatory changes in Phase 1 that would allow for infrastructure pruning and would guide development of pruning strategy.

ACTION NE-6: Begin Gas Infrastructure Pruning in Areas Where Gas Line Repair/Replacement is Expected to Occur as Equity Guardrails and Foundational Issues Identified in Phase 1 are Addressed.

As the foundational regulatory issues are resolved at the State level, the City of Berkeley and PG&E will be able to begin identifying opportunities for gas line pruning. Savings from avoided gas infrastructure maintenance would be used to offset the cost of electrification for building owners. Through this action, infrastructure pruning would target areas where gas line repair/replacement is expected to occur, thereby using fund for electrification projects that would have been spent on costly maintenance of the gas infrastructure.

5. A CALL TO ACTION

INTRODUCTION

Electrifying all Berkeley's existing buildings is a large and complex undertaking that - if done in an inclusive and equitable way - provides an enormous opportunity to bring many benefits to the community including making our homes and indoor spaces healthier, safer, more resilient, and comfortable, while also taking actions to address the climate crisis and other societal issues such as affordable housing, high road workforce development, and racial equity.

In order to achieve these goals, the work will require collaboration and collective action from the City, community members, community leaders and organizations, the private sector, utilities, and other local, State, and federal entities. This call to action outlines some of the key areas that Berkeley's community and partner cities can take from this Strategy and implement today both as individuals and collectively to advance building electrification.

WHAT CAN BERKELEY COMMUNITY MEMBERS DO NOW?

The modeling conducted for this project shows that many buildings within the City of Berkeley can be electrified today in a cost-effective manner. While some community members will need funding and financing access or other support to make electrification feasible (and it will take some time to develop and scale these solutions), there are key situations when electrification should be considered today. While these solutions are geared toward the City of Berkeley, they may also be applicable to other communities across the State.

Purchasing a New Home

When purchasing a new home in Berkeley, it may be possible to include the costs of electrification in your mortgage as part of a green mortgage or energy efficiency mortgage. Although high-cost housing conditions make these products more challenging in Berkeley, opportunities do exist. Financing electrification could provide positive cash flow upgrades to the home as well as higher comfort.

At Time of Replacement or Renovation

Some incentives are already in place to support replacing gas appliances like water heaters and HVAC units for electric ones. When equipment fails or nears the end of its usefulness, it is worth investigating heat pump technologies and any available incentives.[131] While heat pumps may increase upfront costs in the short-term, the monthly savings will pay off over time. Electrifying at time of renovation could also represent lifetime cost savings due to lower upfront marginal costs. When renovating a kitchen or garage, it may be ideal to ensure 220v wiring exists where an electric appliance like a stove or dryer may be located in the future.

131 *The BayREN Home+ website is a great resource for finding contractors and additional information. https://bayren-residential.org/*

Install Heat Pump AC When Installing a New AC Unit

Residents who are considering purchasing a new or replacement air conditioning unit, especially those who have an older HVAC unit, should consider making the switch to an efficient heat pump HVAC unit that provides both heating and cooling instead. The incremental cost of adding heating to an AC system is low and provides an opportunity for efficient electric heating. By combining both heating and cooling into one unit, the upfront and operating costs are likely to be lower.

Installing Solar with Battery or Thermal Storage

Homes installing solar and/or battery storage for other reasons like cost savings and resiliency could increase those savings by electrifying more appliances and upsizing the solar array to achieve net zero electricity purchases. In addition to battery storage, heat pump water heaters can act as a thermal battery, "charging" up during the day using solar energy to heat water to a high temperature and providing hot water through the evening hours.

Lower Your Carbon Footprint

Simply put, some community members have the desire and the means to lower their carbon footprint and building electrification is a great way to achieve that. Replacing stoves for induction technologies and HVAC, water heaters, and dryers with heat pumps allows building owners to achieve carbon neutral building operations today when paired with renewable electricity through East Bay Community Energy.

Learn More

Both residential and commercial buildings can take advantage of BayREN significant electrification rebates and resources, and East Bay Community Energy is currently offering a discounted solar and storage program.[132]

For more information on how to electrify your home including information on rebates and incentives see: https://www.cityofberkeley.info/electrification/. Residents can also learn more about electrification at The Switch is On: https://www.switchison.org/.

132 *https://ebce.org/solar-battery/*

WHAT CAN OTHER CITIES DO?

This Strategy focuses specifically on Berkeley's building stock, climate, and communities, and, therefore, many of the costs and actions developed for this Strategy are specific to the City. However, there are aspects of this Strategy that could be applied to other cities and can serve as a starting point to build on the analysis completed for Berkeley.

What Can Be Applied to Other Cities?

Equity Guardrails

Many cities in California, similar to Berkeley, are increasing their focus on equity and how to include all of their communities in the decision-making process. While discussing equity in plans and policies is a good place to start, there are not yet many mechanisms to apply equity to electrification policies and actions in a structured way. The development of the equity guardrails and subsequent equity guardrail analysis helps the City to both conduct outreach and engagement with its marginalized communities and provides a process through which to analyze the impacts of a policy or action and identify any shortfalls in the overall approach. While the specific content and priorities of the equity guardrails may vary across cities, refining them in collaboration with the affected communities and using the guardrails as a mechanism to evaluate potential policies, offers a flexible approach to integrate equity into other policy making documents.

Framework

While the specific actions of this Strategy may or may not apply to other cities, the overall framework and primary policies identified as part of this report are likely also to be the key levers that other cities can pull to incentivize or mandate existing building electrification in their own communities. A foundation built on equity and the supporting pillars of education, funding and financing, and major policy changes will likely be needed to support existing building electrification in every city.

What Can Other Cities do to Get Started?

Building Inventories

The first step that cities should take when formulating a plan for existing building electrification is to get a strong understanding of the existing building stock. Information including number of and type of buildings, residential units, construction types, vintage, and square footage will be important data points for conducting a cost analysis and prioritizing actions.

Community Engagement with Equity Focus

The only way cities will be able to achieve full electrification and be free of fossil fuels is to design inclusive policies that include all buildings in an affordable and accessible way. Existing building electrification is an extremely multifaceted topic that impacts how people live and experience their homes and living spaces and requires collaboration and a deep understanding of community needs prioritizing those who have been historically disadvantaged. Building trust within these communities to collaboratively perform this work is a long-term commitment that requires early and ongoing engagement. The projected costs and other ramifications associated with electrification upgrades should be discussed and fully understood, and policies should be developed in partnership with the communities most impacted. Engaging diverse communities will require dedicated funding and resources that should be included in the scope and prioritized from the very beginning of any development of community scale electrification solutions.

What Can We do as a Group of Cities?

Advocate for Policy Changes

Several policies including the obligation to serve, as well as rules dictating how PG&E and other utilities can allocate funds for gas infrastructure, can be changed to make electrification easier and more cost-effective. One city alone cannot effectively lobby for these statewide changes; however, a coalition of cities can raise these issues more effectively and lobby for constructive change.

Advocate for funding & financing programs

Advocating for accessible funding and financing programs is one of the biggest actions that cities can undertake together. Once a robust set of programs is in place, existing building electrification is going to be a much more equitable and feasible process. For example, a group of cities advocating at the State and local level for an accessible tariffed on-bill financing program would help spur action and accelerate the timeline for implementation of Phase 2 and Phase 3 actions.

Advocate for Equitable Utility Rates

Gas rates - Regulated utility rates have a major impact on the economics of electrification. Gas rates do not currently reflect the societal costs to climate, safety, and health and are thus artificially low in comparison to electricity rates, which include costs for social benefits, such as incentives for rooftop solar.

Electricity rates - As Berkeley seeks to elevate measures that support targeted universalism and community-driven solutions, rooftop solar presents some interesting challenges. While the current Net Energy Metering (NEM) rate structure improves the economics of residential electrification for a customer with solar access and the ability to invest in PV, it also presents challenges that need to be considered in defining a long-term approach that centers on equity.

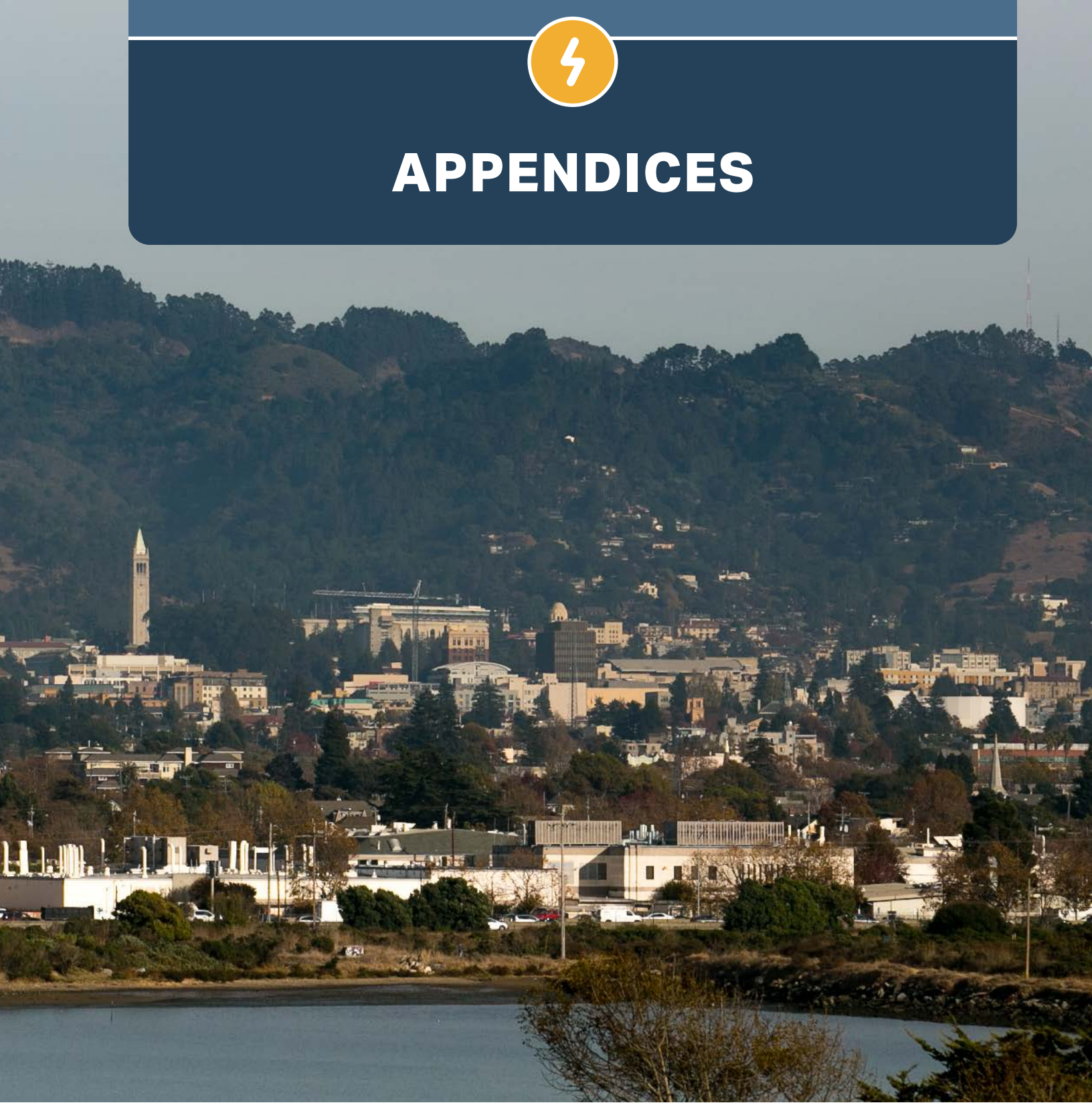
While NEM benefits customers with rooftop solar, it shifts costs for maintaining the electricity grid to other customers, increasing electricity costs.

Together, California cities can advocate for rate structure changes at the CPUC that fairly reflect the current and future costs of gas and electricity rate revisions that continue to support renewable energy sources and are equitable to all rate payers, especially those that cannot utilize rooftop solar.

Pilot Projects

There is still much to learn about the nuances of building electrification. While this analysis took a deep dive on local costs and utilized a detailed energy model to predict costs, there is no substitute for on-the-ground data. As more cities conduct pilots and share outcomes, new approaches will likely be developed to help lower costs and improve the electrification process.

APPENDICES



APPENDIX A:
TECHNICAL APPENDIX

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Technical Appendix

Modeling Process

The energy and cost analysis that informs this report was performed with a custom tool produced by Radiant Labs Analytics. The tool utilizes a National Renewable Energy Lab (NREL) ResStock modeling engine to develop hourly building energy models for every home in Berkeley based on over 50 prototype models scaled to each individual home's square footage. This tool used a comprehensive building inventory developed by Cadmus Group and the Building Electrification Institute (BEI) that compiled information from a wide range of public and private sources including the Alameda County Tax Assessor's database, Berkeley's Building Emissions Savings Ordinance (BESO), other city departments, federal housing programs, and geospatial data tools.

This analysis addresses the four-primary gas-using building components in existing Berkeley homes: space heaters, water heaters, stovetops, and clothes dryers. These technologies were combined into packages to model the costs associated with electrifying an entire building. Electric vehicle upgrades and ancillary end uses including gas fireplaces, outdoor barbecues, and gas-heated pools were not considered. Battery storage systems were also not included in the modeling.

Measures were defined for three electrification packages[1]:

- **Package 1: Economy Products** reflects the most commonly sold products from regional distributors. Measures include a single-speed air source heat pump (ASHP), 50-gallon heat pump water heater (HPWH), electric resistance cooktop, and electric resistance clothes dryer.
- **Package 2: Mid-Tier Products** includes more expensive products with additional energy benefits. Measures include a variable-speed ASHP, 80-gallon HPWH, induction cooktop, and heat pump clothes dryer.
- **Package 3: Mid-Tier Products + Envelope** includes all Package 2 measures in addition to air sealing and roof insulation measures.

Each existing building systems were defined based on information collected through RealQuest or Berkeley's Building Emissions Savings Ordinance wherever possible, and otherwise statistically modelled through ResStock based on the regional trends detailed in the US Energy Information Administration's (EIA's) Residential Energy Consumption Survey.[2] Electrification upgrades were only applied to homes not assumed to have electric equipment already in place (e.g., we did not model induction stove upgrades for homes with existing electric resistance cooktops).

The ResStock platform utilized EnergyPlus modeling software to model energy and cost impacts for a set of energy measure packages defined to model a range of current technological options for electrifying Berkeley's existing homes. Measure packages and cost assumptions were developed through stakeholder interviews and by profiling the assumptions utilized in past research efforts, most notably E3's 2019 report "Residential Building Electrification in California: Consumer

1 Note that measures were developed with a focus on the systems that are commonly installed in 1-4 family homes, which make up over 80% of Berkeley's buildings. Some multifamily homes can use these same products, but many are constructed with lower-cost central systems that present a wider range of design options and cost considerations for electrification retrofits.

2 https://www.eia.gov/consumption/residential/

Economics, Greenhouse Gases, and Grid Impacts".[3] Utilizing these localized analyses was essential for reflecting the uniquely high costs associated with the Bay Area housing and contracting markets.

The methodology and input assumptions behind NREL's ResStock platform are detailed in NREL's "Energy Efficiency Potential of the U.S. Single-Family Housing Stock".[4] The following contents detail other core assumptions utilized for modeling the impacts of building electrification in Berkeley.

Key Inputs

Lifecycle Cost Analysis

This economic analysis assumes that building systems are replaced at point of failure: paybacks and financed cashflows only incorporate the incremental cost of replacing an end-of-life unit with an electric system (e.g., an air source heat pump) rather than a comparable natural gas system.

Financing cashflows and estimated breakeven incentives assume a Pay As You Save® tariffed on-bill financing program. The terms utilized in analysis are detailed in Section 3.3 of the Berkeley Existing Buildings Electrification Strategy. For measure packages with a solar system, the estimated present value of solar production in years 20-25 (which is not covered under typical PAYS® terms but can be reliably financed in other programs) is credited to offset upfront costs.

Utility Rates

Savings for each measure are based on modeled energy savings and the following utility rates, modeled after PG&E's E-1 tiered electricity rate and residential natural gas rate[5] (Table 1). Time-of-use rate tariffs like PG&E's E-TOU-C were not for this analysis due to limitations in the modeling software.

Table 1 Assumed Utility Rates

Fuel		Rate
Natural Gas	–	$1.66/therm
Electricity	Tier 1	$0.23/kWh
	Tier 2	$0.29/kWh
	Tier 3	$0.51/kWh

Daily overproduction from solar systems was compensated with the same tariff structure. This model does not account for non-bypassable charges: these charges, which make up roughly 2.7 cents/kWh under PG&E's current E-1 tariff[6], are not included as part of solar overproduction compensation under Net Energy Metering 2.0 rules. All analysis assumes a natural gas rate of $1.66 per therm based on reported PG&E residential rates at the time analysis was performed.[7]

3 https://www.ethree.com/e3-quantifies-the-consumer-and-emissions-impacts-of-electrifying-california-homes/

4 https://www.nrel.gov/docs/fy18osti/68670.pdf

5 https://www.pge.com/tariffs/Residential.pdf, https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHEDS_E-1.pdf

6 See https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHEDS_E-1.pdf. All charges outside of generation, distribution, and transmission are non-bypassable.

7 https://www.pge.com/tariffs/Residential.pdf

HVAC System Assumptions

Existing Fuel Sources

As shown in Table 2, Energy Information Administration (EIA) data suggests that virtually all existing homes in Berkeley use natural gas for heating:

Table 2 NREL/EIA Fuel Source Estimates for HVAC in Berkeley

Fuel Type	Number of Buildings	Percentage
Gas	40,994	99%
Electric	362	1%

BESO data covering existing heating systems is limited to a small sample, but generally supports the assumption that most homes have natural gas systems: 45 of the 46 homes surveyed used natural gas furnaces.

Air conditioning ownership in Berkeley is difficult to determine, but available data suggests 5-17% market saturation:

- 60 of 1,281 audited homes (5%) tracked through Berkeley's BESO program had air conditioning systems.
- Permit data suggests that at least 2,130 homes in Berkeley have existing air conditioning systems, roughly 5% of the housing stock. Assuming a permit compliance rate of 30% suggests a true ownership rate of closer to 17%.[8]

Electrification Options

Table 3 shows the two options for electrifying HVAC systems in Berkeley that were considered in this report. The economy package uses lowest-cost appliances while the mid-tier package uses more efficient appliances at a higher installed cost.

Table 3 HVAC Electrification Costs in Berkeley

Package	Cost	Incentive	Details
Economy Package	$9,036 + $756/ton	-	Single speed, 14 SEER, 8.2 HSPF
Mid-Tier Package	$12,125 + $756/ton	$1,000	Variable speed, 21 SEER, 13 HSPF; rebate provided by BayREN
Natural Gas Baseline	$6,903 for furnace $16,387 for furnace + AC[1]	-	Assumes a 40 MBH furnace (80 AFUE) and 2-ton air conditioner (SEER 14)

[1] The cost of existing/planned whole-house air conditioners is not considered in default economic analysis for electrification measure packages due to a limitation in modeling software.

SEER- Seasonal energy efficiency ratio

HSPF – Heating season performance factor

8 A 2012 study found a 30% permit rate for residential air conditioning projects in Sacramento. Source: http://www.calmac.org/publications/HVAC_WO6_FINAL_REPORT_VolumeI_22Sept2017.pdf

MBH – Thousand British thermal units per hour
AC – Air conditioning
AFUE – Annual fuel utilization efficiency

The modeling tool utilized for this report auto-sizes HVAC systems for the loads of each home in Berkeley and estimates installed gas (baseline) and heat pump (proposed) system costs based on that sizing.

Heat pump systems can heat a home 3-5 times more efficiently than any natural gas furnace while also providing cooling in summer months. The single-speed central system specified in the economy package is typically sufficient for Berkeley's mild climate. However, variable-speed systems yield additional consumer and grid benefits:

- **Improved Efficiency.** The mid-tier heat pump modeled in this study used roughly 35% less energy for heating and cooling than the economy product, further reducing utility bills and minimizing grid impacts.[9] While the utility bill impact is clear, the grid benefit could come in the form of reduced transmission and distribution or supply constraints, as more efficient units will use less energy and contribute less to peak demand.
- **Guaranteed Comfort.** Variable-speed heat pumps scale output based on demand rather than cycling on-and-off, minimizing indoor temperature swings.

Many air source heat pump products are offered with smart controls that enable homeowners on time-of-use rates to reduce their utility bills by operating equipment during lower-cost hours.

The modeling detailed in this report does not incorporate two important alternatives to central ducted systems that warrant consideration in any program design:

1. **Mini split Heat Pumps.** These units were not modeled because they are typically more expensive than ducted central systems and less cost-effective in Berkeley's mild climate. However, they can be sensible choices in homes with damaged, insufficient, or nonexistent ductwork[10], where central system installation may be more costly. Mini split systems can be substantially more efficient (and thus grid-friendly) than central systems and may warrant utility incentives.
2. **Packaged Terminal Units (PTACs).** Heat pump PTACs simplify installation by combining the indoor and outdoor heat pump components into a single through-wall unit. Some units operate at 120V on 15A panels, meaning that they can even be plugged into an existing outlet. These units mitigate the need for new wiring (an estimated average cost of $720 per home in Berkeley) and potentially even an electrical panel upgrade. Quality product offerings are currently limited in the United States, but the market share may grow quickly.

9 Based on nameplate ratings: SEER 21 and HSPF 13 for mid-tier, SEER 14 and HSPF 8.2 for economy.

10 Local installers estimate that at least half of Berkeley homes with central furnaces (the most common heating system type) warrant duct replacements or major repairs.

Domestic Hot Water Assumptions

Existing Fuel Sources

As shown in Table 4, EIA and NREL data suggest that roughly 7% of Berkeley homes already use electricity for water heating. The data also suggest that a small number of homes in Berkeley still use fuel oil or propane systems for heating. Buildings using propane or fuel oil represent prime targets for initial electrification due to the higher costs of these fuels.

Table 4 NREL/EIA Fuel Source Estimates for Domestic Hot Water in Berkeley

Water Heating Method	Number of Units	Percentage
Gas Standard	36,942	89%
Gas Tankless	1,244	3%
Electric	2,760	7%
Fuel Oil and Propane	410	1%

BESO data suggests that the number of homes that use natural gas for water heating could be even higher than estimated through the NREL and EIA data: 1,255 of 1,270 homes surveyed (99%) used natural gas, with the remainder using electricity. This number may also be skewed by the number of unpermitted installations, which may more heavily favor non-grid-connected fuel sources like fuel oil and propane.

Many of the existing electric water heating systems are likely electric resistance, and therefore less efficient and more costly to operate than a new heat pump water heater. Converting these units to higher-efficiency heat pump water heaters can be important even though they will not displace gas appliances. Converting from electric resistance to heat pump water heating is often cost-effective. Further, heat pump water heaters typically consume much less electricity, limiting energy supply and transmission and distribution issues if converted across a community.

Electrification Options

The 50-gallon Heat Pump Water Heater (HPWH) systems modeled had a first-hour rating of 70 gallons, which should be sufficient for most homes outfitted with the low-flow fixtures already required by the City.[11] However, 80-gallon systems can be paired with smart control systems to further reduce energy costs by using excess capacity to shift operating times to off-peak, lower-cost, and/or less-carbon intensive hours. Some utilities are promoting the technology as a peak load reduction measure.

As shown in Table 5, the economy and mid-tier electrification packages are compared against two different baselines: a 50-gallon tanked natural gas model and a tankless natural gas model, respectively.

11 https://www.cityofberkeley.info/uploadedFiles/Online_Service_Center/Planning/SB%20407%20COB%20Guideline.pdf

Table 5 DHW Electrification Costs in Berkeley

Package	Cost	Incentive	Details
Economy Package	$3,761	-	50 gallon, 3.0 UEF
Mid-Tier Package	$4,651	$1,000	80 gallon, 3.0 UEF; rebate provided by BayREN
Natural Gas Baseline	Economy: $2,096 Mid-tier: $2,794	-	Economy: 50-gallon tank, 0.63 UEF Mid-tier: 190 MBH tankless, 0.81 UEF

UEF – Uniform energy factor

Clothes Dryer Assumptions

Existing Fuel Sources

As shown in Table 6, NREL/EIA data suggest that most clothes dryers in Berkeley are already electrically powered (presumably electric resistance rather than heat pump):

Table 6 NREL/EIA Fuel Source Estimates for Clothes Dryers in Berkeley

Clothes Dryer Type	Number	Percent
Gas	13,528	33%
Electric	26,167	63%
None	1,661	4%

Electrification Options

Electrifying gas clothes dryers consistently results in a utility bill increase in PG&E's utility territory, with the technology typically yielding greater bill increases than any other electrification measure. Electric resistance models result in particularly poor bill impacts.[12] Heat pump clothes dryers do yield better bill impacts but are more expensive and can be substantially slower at drying clothes.[13] Homeowners with time-of-use electric rates can improve these bill impacts by purchasing units with smart controls that only allow runtime during off-peak hours.

Table 7 Clothes Dryer Electrification Costs in Berkeley

Package	Cost	Incentive	Details
Economy Package	$1,907	-	Electric resistance
Mid-Tier Package	$2,507	$300	Heat pump; rebate provided by BayREN
Natural Gas Baseline	$1,813	-	Natural gas

This analysis does not include shared laundry services in multifamily buildings, which can be converted at a significantly lower per-unit cost than washers and dryers in single family homes.

12 Energy + Environmental Economics, "Residential Building Electrification in California", 2019. See Figure 3-16.

13 https://www.consumerreports.org/laundry/energy-saving-laundry-tips/

Higher usage rates for these shared systems may also present a problem for building operators required to use a system type that results in higher utility bills.

Some Berkeley homeowners may also be willing to consider a substantially lower-cost option: drying their clothing on clotheslines. Berkeley's mild climate makes this a relatively reasonable option. Modeling for this report did not consider this option to ensure that building electrification provided an equivalent service to all Berkeley residents.

Stove Assumptions

Existing Fuel Sources

Table 8 NREL/EIA Fuel Source Estimates for Cooking Stoves in Berkeley

	#	%
Gas	26,298	64%
Electric	14,627	35%
Propane	432	1%

Most Berkeley homeowners utilize gas appliances for cooking. Most existing electric cooktops are likely to be either coil top electric resistance or smooth top electric resistance units.

Electrification Options

Table 9 Cooking Stove Electrification Costs in Berkeley

	Cost	Incentive	Details
Economy Package	$1,827	-	Smooth top electric resistance cooktop and oven
Mid-Tier Package	$2,057	$300	Induction cooktop, electric resistance oven. $300 rebate provided by BayREN.
Natural Gas Baseline	$1,126	-	Gas range and oven

This analysis did not consider coil-top electric ranges, which can be purchased at significantly lower cost today, because these products are typically considered as substandard in comparison to gas ranges. Smooth top ranges provide a better user experience and can mitigate the significant fire risk associated with coil top ranges.[14]

Induction cooktops work by using magnets to heat the molecules in the pot or pan directly, so they deliver heat more quickly and efficiently to the food. They turn on and off instantly and offer more precise control over temperature, providing faster cooking times and more power to customize the heat and rate of cooking. Additionally, induction cooktops pose less of a safety risk from burns or fires than either gas or electric resistance stoves, as they have no open flame and turn off immediately when the pot is not covering the burner. These products are now largely considered superior to gas cooktops by Consumer Reports.[15] Incentivizing a switch to induction cooktops upon

14 https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/US-Fire-Problem/Fire-causes/oscooking.pdf

15 10 of the top 10 products in Consumer Reports' 2019 Best Cooktops list were induction.

electrification and providing education around the adverse health impacts of cooking with gas could mitigate the backlash associated with losing gas cooking options.

Envelope Improvement Assumptions

Existing Conditions

Each existing home's envelope performance was modeled using NREL's ResStock tool, which assumes levels of insulation and air sealing based on known building traits and regional construction trends.

Retrofit Options

As shown in Table 10, Package 3 incorporates two basic building envelope measures: upgrading roof insulation to R38, and air sealing to reduce the home infiltration rate to 7 ACH50. These measures are applied to each modeled home and priced based on the assumed existing condition:

Table 10 Modeled Envelope Measure Costs in Berkeley

Measure	Existing Condition	Cost	Incentive
Roof Insulation to R-38	Uninsulated roof	$1.66/sf roof	$0.75/sf up to $1000
	R-7 roof	$1.38/sf roof	$0.75/sf up to $1000
	R-13 roof	$1.20/sf roof	$0.75/sf up to $1000
	R-19 roof	$0.92/sf roof	$0.75/sf up to $1000
	R-30 roof	$0.61/sf roof	$0.75/sf up to $1000
Air Sealing to 7 ACH50	Infiltration worse than 7 ACH50	$1.80/sf conditioned floor area	$350

Incorporating envelope improvements in package 3 presents an option that results in better occupant comfort, grid impacts, and energy/carbon savings than electrification alone. In some homes, improving envelope efficiency may have enough of an impact on heating loads that HVAC system can be downsized, a significant upfront cost savings opportunity.

Electrical Panel Upgrades

Existing Conditions

Little information is readily available concerning the state of Berkeley's electrical distribution infrastructure, but interviews with local installers and utility representatives suggest that the majority of Berkeley homes do not have the 200A panel necessary for whole-house electrification with standard-sized products. The models utilized for this report assumed that homes constructed before the year 2000 had insufficient panel capacity for whole-house electrification unless a panel upgrade was identified through City of Berkeley building permit records.

Note that research from E3 suggests that only homes constructed before 1978 (the year of initial adoption for Title 24 of California's building code) will require panel upgrades to provide sufficient capacity for electrifying HVAC and hot water heating systems.[16] However, energy and cost models

16 Energy + Environmental Economics, "Residential Building Electrification in California", 2019.

must also consider the likelihood that these homes will also install EV charging, rooftop solar PV, and/or battery storage systems before the existing panel's end of life.

Retrofit Options

The estimated $3,000 cost for this upgrade is based on interviews with several local contractors and utility representatives, who reported an overall range of $1,500 to $5,000 for upgrades (Table 11). Some homeowners may be able to avoid this cost and complication by instead investing in lower-capacity systems, envelope improvements, and/or "smart" sub-panels to minimize peak power draw.

Table 11 Electric Panel Upgrade Costs in Berkeley

	Cost	Incentive	Details
Panel Upgrade	$3,000	-	Only applied to homes built before 2000 that do not have an identifiable permit for past upgrades[1]

Modeling for this report assumed that building electrification projects account for the full cost of the panel upgrade. Other modeling efforts have applied some or all the panel upgrade cost to electric vehicle purchases. Future modeling efforts should consider these conversions in parallel to accurately address the cost of panel upgrades.

This analysis does not include the cost of upgrading the knob-and-tube wiring that is prevalent in older Berkeley homes. While homeowners can typically avoid the cost of this upgrade by powering newly electrified equipment with new wires, knob-and-tube wiring represents a safety issue that could be resolved as part of a whole-home electrification retrofit.

Some Berkeley homes will also require an upgrade to the service drop line, or the electrical line between a home's main electrical panel and electrical distribution infrastructure. This cost is typically borne by the utility and spread across by all electric ratepayers.

Rooftop Solar PV

Existing Systems

Berkeley permit data analysis found solar PV systems attributed to 3,231 low-rise residential housing units (8% of the low-rise housing stock).

The modeling platform utilized for this report uses building inventory data and spatial information to model solar system production for each home, although it does not allow users to easily differentiate between homes with good/average/poor solar performance. Google's Project Sunroof suggests that most homes in Berkeley are good candidates for a solar PV system:[17]

- 88% of rooftops are solar-viable[18]
- 69% of all rooftops can support a 5+ kW solar system
- 58% of all roofs are flat or south-facing
- Solar-viable rooftops produce an average of 1410 kWh/year per kW-DC installed

17 https://www.google.com/get/sunroof/data-explorer/place/ChIJ00mFOjZ5hYARk-l1ppUV6pQ/

18 Solar-viable: Any rooftop where an installation would reach at least 75% of the efficiency of an optimally oriented and unshaded system.

Electrification Options

This analysis incorporated three solar PV options for each measure package:

- **No PV** does not incorporate new solar PV (existing systems identified through BESO or Permit data are modeled).
- **Offset PV** systems are sized home-by-home to meet the modeled energy consumption of the newly installed electric equipment in any given package. Systems are sized on a home-by-home basis.
- **Net Zero PV** systems are sized home-by-home to meet the modeled energy consumption of the entire home over the course of a year, including all pre-existing electrical equipment.

All three systems use the same cost assumptions summarized in Table 12 below.

Table 12 Solar PV Upgrade Costs in Berkeley

	Cost	Incentive	Details
Solar PV	$3.35/W-DC installed	$0.80/W-DC installed	Only applied to homes built before 2000 that do not have an identifiable permit for past upgrades[1]. Incentive reflects 2020 Investment Tax Credit (ITC) value of 26% of installed cost.

The savings assumed from the federal ITC will disappear as that program sunsets by the end of 2024. But installed costs are projected to continue declining, with total installed costs in 2028 dropping below 2020 net costs.[19] Costs may compress even faster in California due to the installation volume necessary to meet the state's zero energy performance requirement for new homes.

Note that home electrification can dramatically improve the resilience of homes in grid outages if solar PV systems are installed with smart inverters, which allow homes to continue using solar power during grid outages. These systems typically represent an added cost of $350-400.[20] Battery storage systems can further improve resilience.

Additional Electrification Considerations

Electromagnetic Sensitivity and Pacemakers

The City is aware of potential implications of electrification on both electromagnetic sensitivity and pacemakers. The City will continue to monitor guidance from State agencies on these topics and will update the measures and actions as applicable. However, individuals should always consult a medical professional with their specific cases.

Refrigerants

Many refrigerants have a higher global warming potential than carbon dioxide.[21] Electrification of gas appliances will increase the use of refrigerants due to the use of heat pumps. However, hotter

19 Rocky Mountain Institute, "Economics of Zero Energy Homes: Single Family Insights", 2018.

20 Justin Dyke, "How to Explain Secure Power Supply to Homeowners," SMA Inverted, last modified May 24, 2016, http://www.smainverted.com/how-to-explain-securepower-supply-to-homeowners/

21 https://ww2.arb.ca.gov/resources/documents/high-gwp-refrigerants

temperatures from climate change will likely increase refrigerant use through air conditioning utilization with or without the efficiency benefits of electrification. The refrigerant issue is not limited to electrification specifically and may not have a discernible impact on Berkeley's overall electrification strategy. The City will continue to monitor opportunities to specify or encourage low global warming potential refrigerants such as carbon dioxide when feasible.

APPENDIX B:
COMMENTS ON DRAFT STRATEGY

Comments on Draft Strategy

The team received stakeholder input throughout 2019 and 2020 to develop the Draft Berkeley Existing Buildings Electrification Strategy, which was released in April 2021 for public feedback. The City held a virtual Berkeley Existing Buildings Electrification Strategy Community Meeting on May 4, 2021 to present the draft strategy and hear feedback from the community. Additionally, the public was invited to provide feedback to an online survey and/or submit written comments via email. In response to the draft report, the City received:

- Over 80 Responses to a public survey
- Over 30 Responses via email
- Additional comments provided during the May 4, 2021 community meeting
- Written comments from the Berkeley Energy Commission, the Rent Stabilization Board and the Construction Trades Workforce Initiative

The team reviewed all comments and incorporated feedback into the final Strategy. This appendix includes the written comments received.

April 28, 2021

Draft BEC Comments on Draft BEBES

The Berkeley Energy Commission supports the equity lens staff have taken to understand and to layout policies like the “electrification guardrails” to ensure that electrification doesn’t exacerbate existing health, economic and social inequities. It is unique and well considered approach that will help all Berkeley residents benefit from electrification.

We realize this is a draft and offer our comments in this light. There could be several changes to improve the readability of the report and the ease with which people can access the salient points such as:

- Create an executive summary.
- Use more iconography to highlight primary points.
- Lead with an explanation of what electrification is. Include a single page diagram with main points.
- High road jobs creation is a questionable first call out for a report about reducing GHGs through electrification. First call out should be what is electrification.
- Move the modeling data in the middle of the report to an appendix.
- Include the main conceptual graphics on pages 85 and 94 in the executive summary.

While we appreciate the depth of consideration of various policy and funding options we are concerned that the detail with which the information is presented simultaneously gives these ideas more weight that perhaps they merit and begs more questions such as who is the target of which program, and who or how will it be run. In addition, so much attention to detail tends to obscure the overarching recommendations. We recommend highlighting priorities and perhaps moving the detailed analysis to an appendix.

We are concerned about the static, one size fits all approach recommended for electrification. There is evidence that induction cooktops can reset pacemakers. Clothes dryers and drying racks are the cheapest and most environmentally friendly way to dry clothes. A small 15 amp dryer is a quarter of the price of a heat pump dryer where venting is available. In some cases, electric resistance heat may be a better choice than heat pump space heating and a fraction of the cost.

In addition, technologies are changing rapidly, what works today will be obsolete in a year. For example, the Innova/Ephoca, a European residential unitary heat pump space heater, is better for the environment and half the installed cost of a minisplit. New smaller, more efficient, heat pump water heaters are also coming to the market quickly.
We recommend that the report acknowledge the varied and changing options to electrification In addition, we are concerned that this narrow set of electrification

strategies and anticipated cost are being given too much weight in the determination city policy, both in terms of the speed at which the city can electrify equitably and what technologies are appropriate. Innovation may cause costs to drop more quickly than we can predict. Again, we recommend more of a summary or highlight approach to the discussion of cost benefits of electrification.

Finally, while electrification of buildings is to acknowledge the broader context of overall climate and environmental impacts and the time value of carbon.

- Almost all heat pumps currently rely on persistent, toxic, high GWP refrigerants. While CARB regulations will slowly lower the GWP of the refrigerants, equipment choices should reflect the potential for leakage of these chemicals. Foam plastic insulations are also toxic, dangerous in fires and some contain high GWP blowing agents.
- Because of these and other high embodied carbon materials, remodeling can lead to high CO2 emissions before a project is even occupied and CO2 savings from the efficiency gains may not realized for decades. Because of reinforcing feedback loops (the Time Value of Carbon concept), a pound of CO2 released today is far more significant than a pound released in 20 or even 10 years.

Thank you so much for your efforts.

Rent Stabilization Board

May 14, 2021

Billi Romain
Manager, Office of Energy and Sustainable Development (OESD)
Katie Van Dyke
OESD Climate Action Program Manager/Chief Resilience Officer
1947 Center St. 1st Floor
Berkeley, CA 94704

Dear Ms. Romain and Ms. Van Dyke:

The Berkeley Rent Stabilization Board appreciates this opportunity to provide comments on the Draft Existing Buildings Electrification Strategy. The presentation that your team provided at our recent Rent Board meeting was incredibly informative and inspiring. I commend the focus on equity, community input, and tenant impact. Electrifying older, rent-controlled buildings will be complex, and care must be taken to prevent a related escalation in rents and tenant displacement.

1. **Berkeley rent control prevents unaffordable pass-through costs on rent controlled tenants but non-rent controlled units will remain unprotected.**

The up-front costs of electrification are significant, and many rent-controlled buildings will need infrastructure and envelope upgrades as well. Such expenses will likely qualify as capital improvements under Rent Board Regulation 1267, but given that the Board uses a fair return analysis, most landlords will not qualify for a monetary pass-through. Capital improvements are amortized at 1%, but can only be passed through to existing tenants as a permanent rent increase if monthly vacancy rent increases for the building since January 1, 1999, are less than the eligible pass-through. It is rare, indeed, for most Berkeley rental property to qualify for capital improvement pass-throughs for buildings, since there has been such significant tenant turnover in the city since 1999. For example, if the landlord otherwise qualifies for $200,000 in capital improvements, $2000 would be eligible to be passed through. If the total monthly vacancy rent increases since January 1, 1999, for the property exceed $2000 (a likely scenario), no pass-through is allowed.

Although capital improvement pass-throughs to existing tenants are rare, we are concerned that the costs of electrification will be passed on as vacancy rent increases that make Berkeley even less affordable, especially for lower-income persons, students, the elderly,

persons with disabilities, and historically marginalized populations. In some cases, smaller costs—like new cookware to accommodate induction stoves—will also fall on tenants. While electrification provides energy cost savings over time, many tenants, like our large student population, may not reside in a unit long enough to realize them in a meaningful way. And important but more abstract benefits like healthier air in units can be overshadowed by the immediate and concrete impacts even small rent increases can have on rent-burdened tenants. **We urge the City to secure all possible funding and subsidies, particularly for low-income landlords, to prevent the considerable upfront costs of electrification from being passed on to tenants as rent increases that contribute to Berkeley's continuing affordability crisis.**

2. Tenant Protections in order to mitigate unsafe and disruptive impacts on tenants.

The prolonged construction related to infrastructure and envelope upgrades may result in disruptive and unsafe living conditions, and potentially permanent tenant displacement. It's important that tenant protection measures are integrated, and have meaningful and accessible enforcement mechanisms. We wish to highlight efforts by the 4 x 4 Joint Committee on Housing—Rent Board & City Council that speak to this issue.

A. Habitability Plan Proposal

Modeled on the City of Los Angeles' practice, we introduced habitability plans as a more holistic approach to tenant protection during construction. In Los Angeles, prior to the issuance of permits, owners must obtain approval of a plan that specifies the responsible contractor, affected tenants and their current rents, scope of work, the specific work to be undertaken, and the severity and potential duration of impacts to the tenants or their personal property. Owners must also specify mitigation measures so that tenants can either remain safely in place, or be temporarily relocated during construction. Mayor Arreguín and the other members of the 4 x 4 Committee are currently exploring the possibility of implementing a similar requirement in Berkeley.

B. Relocation Ordinance Amendments

Only landlords or the Building Official can trigger Berkeley's existing Relocation Ordinance. The Committee has recommended that the Ordinance be amended to, amongst other things: allow a broader range of parties to trigger it, including tenants; strengthen enforcement and appeal mechanisms; and increase the per diem reimbursement rate to current market rates. The Committee also recommended that the City provide funding for

tenant relocation in the event the landlord refuses. Mayor Arreguín is convening a multi-department working group to consider amendments.

3. Monitor new laws.

Lastly, we encourage your support for the Tenant Opportunity to Purchase Act, and efforts aimed at increasing cooperative and nonprofit housing that reduce profit motives and help address split incentives. We also encourage you to monitor proposed state legislation like AB 1139 that would add significant costs to solar and undercut the feasibility of electrification.

Climate change is a critical issue, and we applaud the effort to electrify Berkeley's existing housing stock in a considered way to prevent unintended, harmful impacts. We are especially heartened by the equity guardrails, and the commitment to meet or exceed them before specific policies and programs are implemented. Electrifying Berkeley's rent-controlled housing stock poses special challenges. We look forward to working in partnership to find creative and innovative solutions for building a more sustainable and equitable community while continuing to protect the most vulnerable in our community from displacement.

Sincerely,

Leah Simon-Weisberg, Chair
Berkeley Rent Stabilization Board

CTWI
Construction Trades Workforce Initiative

CTWI Policy Recommendations
City of Berkeley Existing Buildings Electrification Strategy
5/14/21

Construction Trades Workforce Initiative (CTWI) and the Alameda County Building Trades Council are committed to supporting the City of Berkeley in its goals of reducing greenhouse gas emissions while ensuring that people who live and work in Berkeley - especially those from historically disadvantaged populations - have access to high-road, family-sustaining careers in union construction associated with existing building electrification and decarbonization.

We thank you for the opportunity to submit the following proposals and recommendations:

I. Policy Recommendations

A. Address decarbonization overall - building electrification as well as energy efficiency measures - when planning strategies for a "Just Transition" in consultation with all crafts affected, including but not limited to Sheet Metal, Electricians, Carpenters, Plumbers and Pipefitters.

B. Create programs and identify funding sources to incentivize Berkeley homeowners to replace, upgrade and install systems that will achieve energy efficiency goals.

C. Require the use of pre-qualified residential construction contractors that will reliably perform high-quality work and provide high-road careers for workers (see Point II below: Pre-Qualified Contractor Proposal).

D. Link disadvantaged Berkeley residents to training programs that prepare them to enter and succeed in union construction careers by working with and budgeting for ongoing City funding for local Multi-Craft Core Curriculum (MC3) workforce partners, school districts/community colleges and CBOs to develop and sustain a long-term pipeline of work in the residential building retrofit market that carries high-road labor standards.

E. Develop public education campaigns and resources to promote new City programs and the benefits of energy efficient systems and appliances; provide information on systems and requirements; and link homeowners to a list of pre-qualified contractors (see Point II below).

F. Include alternative options for homeowners if electrification of all home appliances and systems is not feasible due to limitations of the house structure itself. For example: If a heat pump cannot be installed, an energy assessment should be provided and homeowners should be encouraged and allowed to install a more efficient gas heater than the previous one.

G. Continue to collaborate with CTWI and the Building and Construction Trades Council of Alameda to shape policies and labor standards leading to family–sustaining union construction careers for underrepresented communities.

II. Pre-Qualified Contractors Proposal

Requiring the use of pre-qualified contractors on existing building electrification/decarbonization construction projects will benefit the City in the following ways:

- Cost savings on permitting and inspection process
- Ensures workers are properly trained and licensed/certified where licensing and certifications exist
- Ensures pathways to apprenticeship opportunities for Berkeley residents
- Long-term cost savings to homeowners ensuring that energy efficiency goals are met through proper installation and quality work
- Enables the City to reach its climate goals in a timely fashion

A. Pre-Qualification Requirements: Prequalification requirements for contractors shall include documentation that the contractor meets clearly defined minimum standards relating to contractor responsibility, including:
   1. Certification that the contractor is in compliance with all applicable licensing, bonding, and insurance requirements;
   2. Certification that the Contractor participates in, makes training fund contributions to, and sponsors apprenticeships from a state-approved apprenticeship program that partners with an MC3 pre-apprenticeship program;
   3. Certification that the contractor provides family health benefits and pension benefits to its workers;
   4. Certification that the contractor has not been convicted of, fined, or penalized for any violation of wage, labor, safety, or building standard requirements within the last five years;
   5. Certification that no surety firm has had to complete a contract or pay for completion of a contract on behalf of the contractor or subcontractor within the last five years;
   6. Certification that the contractor has not had any licenses revoked within the past five years;
   7. Certification that the contractor is not ineligible to bid, be awarded or subcontract on a public works project pursuant to either Labor Code section 1777.1 or Labor Code section 1777.7;
   8. Certification that the contractor has not been cited for any serious, willful or repeat OSHA violations within the last five years as defined under Title 8 of the California Code of Regulations.
   9. Certification that the contractor has a Better Business Bureau rating of "B" or higher.

B. Create an official certification for contractors that pre-qualify for the list, i.e. a "City of Berkeley Energy Efficiency Contractor" rating to help cultivate a corps of contractors to serve the market.

III. Partnership with CTWI

Through an ongoing partnership between CTWI and the City of Berkeley, CTWI can provide assistance to implement the recommended policies listed below.

A. Create and compile a list of contractors meeting pre-qualifications and ready to do the work.
B. Provide education for City Inspectors on the way that systems should be properly installed and maintained.
C. Create opportunities for Berkeley residents and others in the region with small construction contracting businesses to learn how to become signatory to the unions in their trades and work effectively under workforce agreements.
D. Provide education for City of Berkeley departments, staff and job seekers on the union construction labor market and workforce development opportunities through MC3 pre-apprenticeship training.
E. Support with pursuit of funding streams for City decarbonization programs.

APPENDIX C:
CITY OF BERKELEY TENANT PROTECTION AND ANTI-DISPLACEMENT INITIATIVES

City of Berkeley Tenant Protection and Anti-Displacement Initiatives

Housing Protection Policies

Amended excerpt from the City of Berkeley's Department of Health, Housing and Community Services (HHCS) Council Report: Partnership for the Bay's Future and Current Anti-Displacement Initiatives, as of February 23, 2021:

https://www.cityofberkeley.info/Clerk/City_Council/2021/02_Feb/City_Council__02-23-2021_-_Regular_Meeting_Agenda.aspx

Housing Protection Policies	Description
Eviction Moratorium	The Berkeley City Council adopted the Berkeley Emergency Response Ordinance to protect residents fromevictions if they are unable to pay rent due to COVID-19's impacts.
Fair Chance to Housing for Formerly Incarcerated People	Property owners are prohibited fromusing criminal background checks to screen tenant applications.
First Source Hiring	First Source hiring ordinances ensure that City residents are given priority for new jobs created by municipal financing and development programs.
Home Retention/RentalAssistance	The City provides financial assistance up to $5,000 for low- income residents at risk of eviction to remain in their currentliving arrangement. Residents impacted by COVID-19 are eligible for up to an additional $10,000.
Just Cause for Evictionordinance	Nearly all 26,000 rental units in Berkeley have eviction protections for no-fault causes.
Landlord/TenantMediation	The Rent Board offers landlord/tenant mediation to settle disputes and facilitate positive long-term relationships.
Rent Stabilization/RentControl	Over 19,000 rental units (approximately 70%) are subject to rent stabilization ceilings.
Relocation Protections and Assistance	Tenants who are mandated to vacate their unit temporarily or permanently at no-fault are provided protections (including a right to return) and relocation funding (provided by the landlord).

Housing Protection Policies	Description
	Rent Ordinance's good cause for eviction provisions require relocation assistance payments when tenants are evicted so an owner or qualified relative can occupy a unit.
Rent Stabilization Board	The Rent Board provides educationto tenants and landlords on tenant's rights related to Just Cause Evictions and Rent Stabilization.
Source of Income Protection	Property owners are prohibited from refusing to rent to an applicant based on their source of income (e.g. Section 8 and other Housing Choice Voucher programs, Social Security, disability, unemployment or veterans' benefits).
Rental Housing Code Enforcement	The Building and Safety Division promotes compliance with applicable housing codes and works to preserve and improve the quality and maintenance of Berkeley's rental housing stock.
Short-Term Rental (STR) Program	An STR is the use of any Dwelling Unit, authorized Accessory Dwelling Unit or Accessory Building, or portions thereof, for sleeping or lodging purposes by a paying guest for less than 14 consecutive days. Anyone operating an STR in Berkeley must obtain zoning approval for the unit and be in compliance with the STR Ordinance. This includes paying all required taxes and fees, providing information to guests regarding the City's Noise and Smoke-Free Multi-Unit Housing Ordinances, notifying the City of changes to Host or Local Contact information, and listing the Zoning Certificate number on any rental advertisement.
Community Land Trusts Acquisition	Northern California Community Land Trust (NCLT) and Bay Area Community Land Trust (BACLT) serve Berkeley and receive direct support from the City for the acquisition and rehabilitation of local properties as well as organizational capacity building.
Condominium Conversion Regulations	The Condo Conversion ordinance limits the conversion of rental units to condominiums to 100 per year and includes an Affordable HousingMitigation Fee for each unit converted. Fees generated from condo conversions provided $3M in revenue for the Housing Trust Fundprogram since 2009. The City of Berkeley's Ellis Act Implementation Ordinance, requires relocation assistance payments if tenants are displaced when an owner removes a property from the rental market.

Housing Protection Policies	Description
Senior and Disabled Rehabilitation Loan Program	The City offers deferred, no-interest loans to assist low-income senior and disabled homeowners in repairing/modifying their homes to eliminate conditions that pose a threat to their health and safety and to help preserve the City's housing inventory.
Single Room Occupancy (SRO) Preservation	The Berkeley Housing Authority provides subsidies for 98 SROs.
Low Income Home Rehabilitation Program	The City provides funding to other home rehabilitation programs to provide no-cost ADA accessibility improvements & health and safety repairs to eligible homeowners
Small Sites Program (SSP) Pilot	The SSP Pilot supported the acquisition and renovation of small, multifamily rental properties with up to 25 units. The City received one application during the pilot and awarded $1.6M to BACLT for the renovation of Stuart Street Apartments.
Tenant Buyout Protections	BMC 13.79.050, Buyout Offers and Agreements, affords protections to tenants who are offered payments to vacate rental units protected by the good cause for eviction provisions of Berkeley's Rent Ordinance.
Foreclosure/Mortgage Assistance	The City participates on the Mortgage Credit Certificate (MCC) Program through Alameda County. MCC recipients may take up to 15% of their annual mortgage interest payments as a dollar for dollar tax credit against their federal income taxes. Qualified homebuyers can adjust their federal income tax withholdings, which will increase their income available to pay the monthly mortgage
Commercial Linkage Fee	This linkage fee on new commercial development generates revenue dependent on the type of development: Office, Retail, and Industrial when greaterthan 7,500 sf. 20% of fees go towards childcare programs.
Housing Trust Fund(HTF) program	The City supports the development and rehabilitation of non-profit affordable housing properties via the HTF program.The HTF is supported by a combination of federal, state and local sources, including theAffordable Housing Mitigation fee. Voters adopted Measure O in 2018 to provide the City with$135M in bond funding for affordable housing.

Housing Protection Policies	Description
Jobs-Housing Linkage fee **(Affordable Housing Mitigation fee)**	All new market-rate housing developments are subject to an Affordable Housing Mitigation fee (AHMF) for each market rate unit built with an option to provide Below Market Rate (BMR) units onsite in-lieu of the fee. The fee adjusts biennially to reflect the Construction Cost Index (CCI) and is discounted if paid at the time of building permit issuance. The AHMF generates the majority of the City's local contribution to the HTF program, with over $12.6M in revenue since 2015. The in-lieu BMR option has provided over 400 permanently affordable units onsite.
Public Land Survey	HHCS conducted a survey to identify opportunities for affordable housing development on City-owned property in 2017 and 2019. West Berkeley Service Center was identified by Council as an opportunity site for future affordable housing development. Vacant City properties were converted into shelters to house homeless individuals at high-risk of COVID-19.

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CITY OF BERKELEY