Introduction

Berkeley has long identified itself as a leader in the fight for the climate, setting first-in-the nation goals and policies to advance climate action. Unfortunately, the policies and programs set out by the City have failed to keep pace with not only its own goals, but the increasing urgency of the climate crisis. Indeed, much of the emissions reductions Berkeley has achieved have come from three primary factors – the increased efficiency and electrification of passenger vehicles, the increased efficiency of building operations due to buildings and appliance standards, and the rapid decarbonization of the electricity grid – improvements that are either predominantly outside the City's control or will take ten to twenty years to fully realize.

Looking at the building emissions sector specifically, the prospects of continuing the pace of emissions reductions using business-as-usual plans are bleak. With the City's transition to 100% carbon-free electricity, there are no credible status-quo policy mechanisms for the City to achieve further reductions in emissions, all of which come from the combustion of natural gas. Yet emissions from natural gas use account for about one-third of the City's greenhouse gas

inventory[1]. Meanwhile, the City's existing plans to address these emissions rely on the now-overturned natural gas ban in new construction, a time-of-sale electrification requirement for single family homes which has been shelved by the current council, and yet-to-be developed emissions standard for large buildings that by all indications would not begin until 2035.

As a result, we believe that substantially more aggressive action is needed to realize Berkeley's existing policy goals and its self-image as a climate leader. We believe that a carbon tax that accounts for the social costs of carbon emissions to incentivize decarbonization and raise money for further electrification efforts city-wide is the most efficient and effective mechanism to achieve the needed building-sector reductions. Such a tax would also prepare Berkeley to demonstrate an equity approach to building electrification, providing technical and financial support for the impending Bay Area Air Quality Management District (BAAQMD) Zero NOx regulations that will take effect in 2027.

The remainder of this paper will lay out the benefits of building decarbonization, the details of existing Berkeley policy, an analysis of the policy landscape, and a description of our preferred policy solution, a Large Buildings Fossil Fuel Emissions Tax.

Benefits of Building Decarbonization

The Berkeley Existing Buildings Electrification Strategy (BEBES) puts the urgency of building electrification in clear terms:

> 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.

Electrification Co-Benefits

Electrification has substantial health, well-being, resilience, and economic co-benefits beyond mitigating climate change and meeting Berkeley's climate goals. There is extensive research showing the numerous health detriments of indoor natural gas combustion.[2] In fact, BEBES notes: "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.[3] Electrification is essential for our residents' health and well-being."

---

[1] https://berkeleyca.gov/sites/default/files/documents/2023%20Climate%20Action%20Plan%20and%20Resilience%20Staff%20Update%20to%20Council_2023-12-12.pdf

[2] https://rmi.org/indoor-air-pollution-the-link-between-climate-and-health

[3] https://coeh.ph.ucla.edu/effects-of-residential-gas-appliances-on-indoor-and-outdoor-air-quality-and-public-health-in-california/

Seventy percent of homes in California utilize gas stoves for cooking, the highest rate in the nation[4]. Homes with gas stoves can have nitrogen dioxide (NO_x) concentrations that are 50–400 percent higher than homes with electric stoves. NO_x has numerous health risks that can damage the respiratory system and increase susceptibility to respiratory diseases. Children are especially susceptible to NO_x and particulate pollution. In a home with a gas stove, children have a 24–42 percent increased risk of having asthma. It is estimated that 12.7% of all childhood asthma in the US can be attributed to indoor gas stoves[5]. Children also show more sensitivity to cognitive impacts and IQ deficits caused by air pollution.

Moreover, the impacts of gas combusted to heat and cool buildings or prepare food extend outdoors into our communities. An estimated 1,527 early deaths per year in California are attributed to outdoor air pollution caused by the combustion of methane gas in buildings. Outdoor air pollution further leads to $17.1 billion dollars in externalized health costs.[6] Indeed, the local air pollution impacts are the basis for the BAAQMD rules prohibiting the installation of new gas water heaters and furnaces beginning in 2027 and 2029, respectively[7].

Installation of electric appliances such as heat pumps will allow for the widespread co-adoption of indoor air conditioning, which will be critical in adapting to higher temperatures from climate change. Extreme heat has already cost California $7.7 billion dollars over the past 10 years, and is substantially more deadly than wildfires; over the last decade extreme heat and has directly killed at least 460 Californians, and an additional 4,000 Californians died indirectly due to the impact of extreme heat on underlying health conditions[8].

Looking locally, Berkeley has a unique risk profile when it comes to climate change. Over 20% of Berkeleyans will be over the age of 65 by 2030[9], and many of these individuals are choosing to age-in-place in un-airconditioned, older homes. Older adults are less able to adapt to changes in body temperature and have substantially elevated risk of heat stroke[10]. It will be imperative to harden these homes against a variety of climatic risks, including not only extreme heat but increasingly common public safety power shutoffs. Building electrification – through heat pumps, solar, and battery storage – can answer this call by providing cooling and energy resilience.

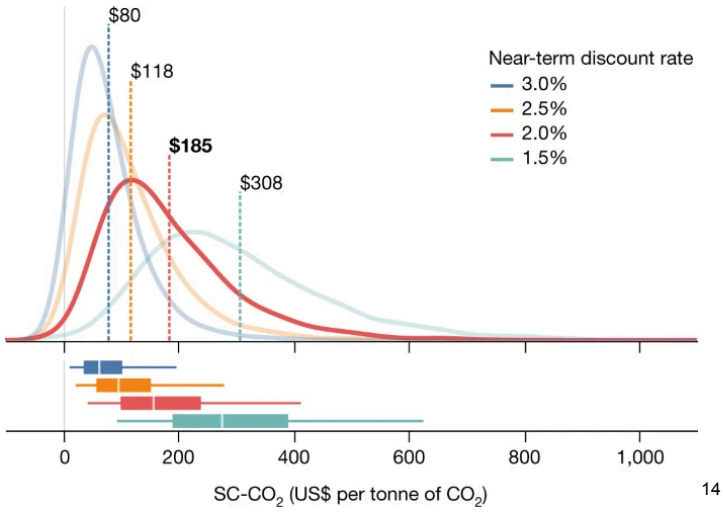
Social Cost of Carbon

The social cost of carbon (SCC) is the estimated economic damage to society with each additional ton of greenhouse gas emissions. The damage is estimated by modeling “what

[4] https://www.nytimes.com/2023/01/18/us/gas-stove-debate-california.html
[5] https://betterbuildingssolutioncenter.energy.gov/sites/default/files/slides/Nothing%20to%20Sneeze%20-%20Slides_0.pdf
[6] https://rmi.org/health-air-quality-impacts-of-buildings-emissions
[7] https://www.baaqmd.gov/rules-and-compliance/rule-development/building-appliances
[8] https://www.usatoday.com/story/news/nation/2024/07/08/extreme-heat-california-hundreds-died-cost-billions/74328414007/
[9] https://www.agefriendlyberkeley.org/about
[10] https://www.cdc.gov/extreme-heat/risk-factors/extreme-heat-and-older-adults-aged-65.html?CDC_AAref_Val=https://www.cdc.gov/disasters/extremeheat/older-adults-heat.html

happens to the climate and how these changes affect economic outcomes, including changes in agricultural productivity, damages caused by sea level rise, and decline in human health and labor productivity."[11] A recent study published in *Nature* estimates that the SCC has been greatly underestimated[12]. Recent work suggests it may even be over $1,000 / ton of emissions![13]

One key reason estimates vary so widely among sources is that economists must choose a 'discount rate' to determine the present value of future costs to mitigate and adapt to climate change, which will increase as the Earth continues to warm. Historically, the federal government's SCC calculation has used higher discount rates, effectively shifting the cost burden of emissions to future generations. The Obama and Biden Administrations use a 3% discount rate, whereas the Trump Administration used 7-10%.



[14]

We argue that a 1.5% discount rate is a more just and equitable discount rate, and perhaps more accurate. We know that climate change is unfolding much faster than anticipated, and that future warming will likely include tipping points and non-linear changes. It is in the public interest and reasonable to discount future damages to a lesser degree to avoid future costs to society now.

What's the Deal With Methane?

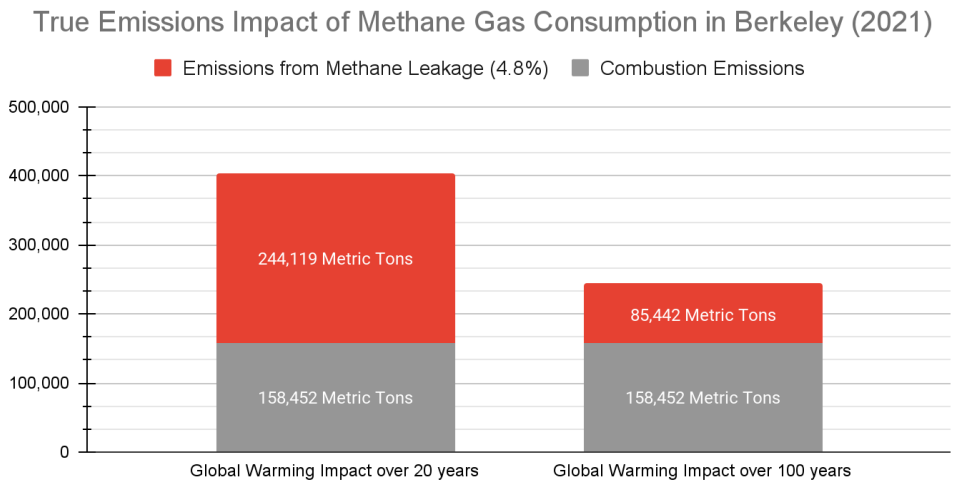
Methane is a primary component of natural gas, meaning that the use of natural gas creates climate-damaging emissions in two separate ways. The first is straightforward: combusted natural gas creates carbon dioxide, and we have discussed the impacts of that combustion in previous sections.

---

[11] https://news.stanford.edu/2021/06/07/professors-explain-social-cost-carbon/#Definition
[12] https://www.nature.com/articles/s41586-022-05224-9
[13] https://www.nber.org/papers/w32450
[14] https://www.nature.com/articles/s41586-022-05224-9. All values in 2020 dollars.

The second is from the methane itself, which leaks throughout the distribution system, and is a potent greenhouse gas. Over a twenty year period, it causes eighty times more warming than carbon dioxide. This higher warming rate, combined with a leakage rate estimated at 4.8%[15], and it becomes clear that policies that reduce demand for methane have a much higher effect than they appear. In fact, a recent study found that "methane emissions from the distribution and use of natural gas across U.S. cities are 2 to 10 times higher than recent estimates from the Environmental Protection Agency."[16]

Berkeley emitted approximately 158,452 metric tons of carbon dioxide from methane gas combustion in commercial and residential buildings in 2021. However, to our knowledge the City currently does not account for the substantial leakage of methane. The added emissions impact of accounting for methane leaked as result of Berkeley's demand for gas is an *additional* 85,442 metric tons of CO_2e over 100 years and 244,119 metric tons of CO_2e over 20 years. That's a 54-154% undercount.[17]



Major environmental groups and the federal government have begun to recognize the outsized impacts methane-related policies can have on our climate future[18][19], with research indicating that approximately 30% of near term warming – almost 0.5 degrees – can be avoided with swift action to reduce emissions[20]. It is thus imperative that cities create policies to reduce demand for natural gas, and that any analysis of the benefits of such policies include the social cost of

---

[15] https://www.research.howarthlab.org/documents/Howarth2022_EM_Magazine_methane.pdf

[16] https://seas.harvard.edu/news/2021/10/urban-areas-across-us-are-undercounting-greenhouse-gas-emissions

[17] 29,947,500 therms of natural gas = 158,452 metric tons of carbon dioxide from combustion; 29,947,500 x 4.8% (leakage rate) x .9 (methane content of natural gas) = 1,293,732 therms

[18] https://www.edf.org/climate/methane-studies

[19] https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-operations/epas-final-rule-oil-and-natural-gas

[20] https://iopscience.iop.org/article/10.1088/1748-9326/abf9c8?addl_info=2021%0AThe%20fastest%20way%20to%20slow%20warming

methane leakage. According to an analysis based on current emissions trajectories (BAU), the social cost per ton of methane emissions exceeds $10,000![21]

Summary

Building decarbonization has substantial benefits to society that must be considered when evaluating the impact of new policies versus the status quo. Namely:

- Natural gas usage has been linked to heightened asthma risk due to poor indoor air quality as well as local pollution that causes premature deaths.
- Heat pumps offer cooling in addition to heating, which improves comfort and prevents deaths due to extreme heat.
- The social cost of carbon is an economic measurement of the damages associated with CO_2 emissions. Estimates vary by discount rate but can reach up to $1000 per ton.
- Natural gas use has an unaccounted for climate impact because of the leakage of methane throughout the natural gas production and distribution system. Estimated leakage is 4.8%, and the social cost of the methane leakage is around $10,000 per ton.
- The use of natural gas creates a clear, measurable harm to society. This harm can be quantified in the social costs of carbon and methane. The reality is The status quo implies that natural gas use is currently *subsidized by society* at these amounts.

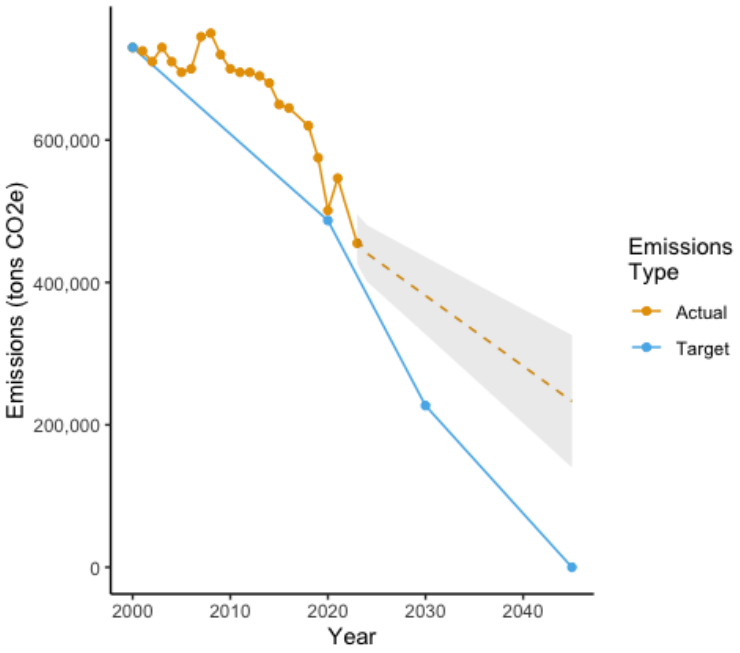
Existing City Climate Emissions Reduction Policies

Berkeley has a long history of setting ambitious climate goals, dating back to 2006 with the passage of Measure G by voters, which was codified into a Climate Action Plan in 2009. At the time, the overall goal of 80% reductions by 2050 and 33% reductions by 2020 were hailed as aggressive. Over time, however, we have learned that they were substantially insufficient, and in 2018, the City of Berkeley established new, more aggressive goals consistent with climate science, committing to 60.5% reductions over 2018 levels by 2030 and zero-emissions by 2045[22].

Unfortunately, our goals have not matched our actual emissions. The following graph shows city emissions plotted against stated city targets; the table below highlights key milestones:

[21] https://link.springer.com/article/10.1007/s10584-023-03540-1

[22] https://berkeleyca.gov/sites/default/files/documents/2021-11-30%20Item%2014%20Cities%20Race%20to%20Zero%20Campaign%20%202030%20emission%20reduction%20target.pdf



Year	Emissions (tons CO_2e)		What	
2000	~730,000		Measure G/Climate Action Plan baseline[23]	
2018	~575,000		Race-to-Zero[24] baseline	
2020	***~487,000 (target)***	501,013	***Measure G/Climate Action Plan target[25]***	Actual emissions 2022 CAP Report[26]
2021	546,388		2023 CAP Report[27]	
2023	~455,000 (est.)		AVA Renewable 100 + Projected annual reduction using 2018-2021 average	
2030	***~227,000 (target)***		***Race-to-Zero 2030 target***	
2045	***0 (target)***		***Race-to-Zero 2045 target***	

23 https://berkeleyca.gov/sites/default/files/documents/2023%20Climate%20Action%20Plan%20and%20Resilience%20Staff%20Update%20to%20Council_2023-12-12.pdf

24 https://berkeleyca.gov/sites/default/files/documents/2021-11-30%20Item%2014%20Cities%20Race%20to%20Zero%20Campaign%20%202030%20emission%20reduction%20target.pdf

25 https://berkeleyca.gov/sites/default/files/2022-01/Berkeley-Climate-Action-Plan.pdf

26 https://berkeleyca.gov/sites/default/files/documents/2022-11-29%20Item%2016%20Climate%20Action%20Plan.pdf

27 https://berkeleyca.gov/sites/default/files/documents/2023%20Climate%20Action%20Plan%20and%20Resilience%20Staff%20Update%20to%20Council_2023-12-12.pdf

As we look at the data, not only did we fall short of our original 2020 goals, we are disturbingly behind on our future goals. Based on data through 2021 and known policies implemented since then, we estimate that the City's 2023 greenhouse gas emissions are about 455,000 tons of CO_2e. Although Berkeley has achieved 38% reductions from 2000 levels to-date, we need to achieve an additional 50% reduction from 2023 levels by 2030. That's over 7% a year! Yet as of writing, we are halfway through 2024 with no major solutions in sight.

Where might these reductions come from? Our existing success to date has largely come from the increased efficiency and electrification of passenger vehicles, the increased efficiency of building operations due to buildings and appliance standards, and the rapid decarbonization of the electricity grid. Berkeley has tipped the scales in all of these places where possible – e.g. by setting more aggressive building standards than the State or converting all electricity accounts to 100% carbon free electricity, but there is very little low-hanging fruit left to pick.

Moreover, outside of electricity, most of these mechanisms rely on time of replacement of equipment or the building – when individuals replace their cars with electric vehicles, when they replace their hot water heaters, or when an old, inefficient home is demolished and replaced by a new one. These cycles take 10-30 years, which is time we do not have. In order to catalyze the next phase of emissions reductions, the City needs to take a deeper, structural approach to emissions reductions, tackling the emissions of *existing* transportation and buildings rather than relying on new ones to save the day.

Building Emissions Savings Ordinance

Within the building sector, the City has recognized the importance of the existing building stock and has developed policy to address them. The centerpiece of the City's policy on existing buildings decarbonization is the Buildings Emissions Savings Ordinance (BESO)[28].

BESO originally went into effect in 2015 and is based on the premise that energy assessments and reporting will eventually lead to emissions reductions measures. Per the Municipal Code:

> Intent. Berkeley Municipal Code Chapter 19.81 (Building Emissions Saving Ordinance – "BESO") was established and amended with the intent of decreasing emissions in existing buildings and lowering the cost and consumption of energy and water by mandating Energy and Electrification Assessments and Benchmarking for existing buildings within City limits. Such information will be made publicly available to inform building owners, as well as prospective buyers and lessees, of building energy performance and worthwhile improvement opportunities. This in turn will encourage cost effective investment in energy and water efficiency, thereby lowering greenhouse gas emissions citywide while contributing to the comfort, safety and health of Berkeley residents

As of 2022, all buildings over 15,000 square feet are required to report their energy use annually. These buildings comprise about 1-2% of the City's building stock but are responsible

[28] https://berkeleyca.gov/construction-development/green-building/building-emissions-saving-ordinance-beso

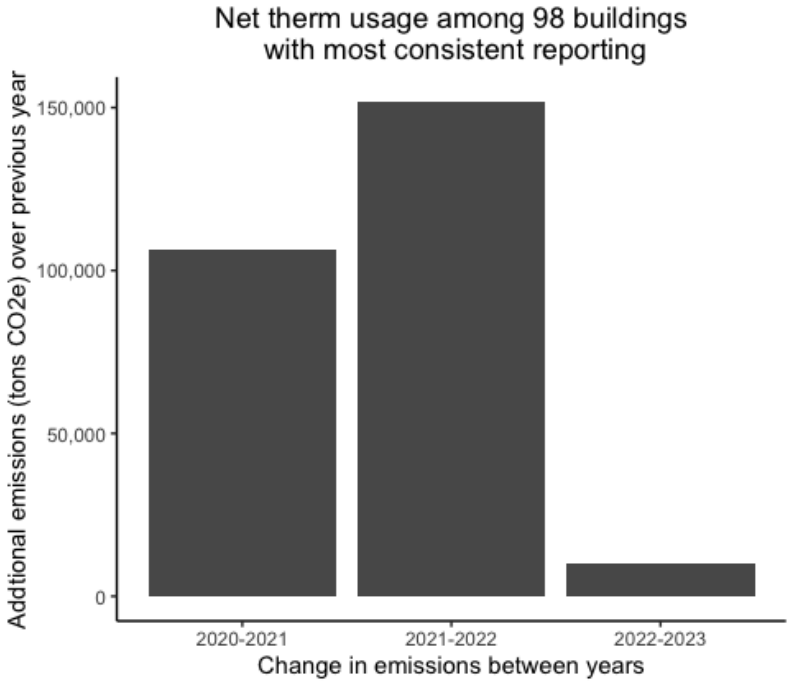
for nearly 25% of building emissions from the usage of natural gas, so they represent a sizable opportunity for impact should BESO's emissions reductions thesis hold.

Unfortunately, BESO's effectiveness seems to be limited, which we hypothesize is due to two factors: poor compliance and lack of any incentive to act on the energy benchmarking.

Though the phase-in of BESO began in 2018, publicly-available data used in this report only goes back to 2020. (2020 is an obvious outlier year due to the COVID-19 pandemic, but due to the lack of 2018 and 2019 data, this report will use the 2020-2023 data for all subsequent graphs.) Of BESO-covered buildings that did not have exempt status in the public data, the rate of completed BESO reports has been steady but has not increased over time:

	Percentage reporting, 2020	**Percentage reporting, 2021**	**Percentage reporting, 2022**	**Percentage reporting, 2023**
All BESO buildings	57.3%	57.2%	60.9%	56.7%*
15k-25k sq ft (small)	48%	51.6%	56.3%	52.3%
25k-50k sq ft (medium)	54.2%	60.2%	61.9%	55.6%
50k+ sq ft (large)	64.9%	65.2%	71.9%	69.6%

However, it is not even clear that increasing BESO compliance will reduce building methane gas usage and satisfy the statutory goal to "decrease emissions in existing buildings." The data show insufficient evidence at this time that BESO reporting is reducing total therms used in BESO-compliant buildings. In fact, net therm usage increased every year amongst the 98 buildings that reported four consecutive years of measurements. Even among buildings who most diligently report their energy use, there seems to be insufficient motivation to meaningfully reduce it.



BESO functions as the baseline policy for reducing emissions in Berkeley buildings in the aftermath of the court defeat of the 2019 gas ban. Though City staff are admirably seeking to extend BESO with a time-of-sale requirement in single family homes and a building performance standard for large buildings in the near future, the pace of improvement is insufficient to meet either existing city commitments or the regional regulatory landscape.

Berkeley Existing Buildings Electrification Strategy

While BESO provides the City its basic policy structure for existing building decarbonization, it is inadequate to achieve deep emissions reductions as it is currently constructed. Moreover, as an isolated piece of policy, it is unable to speak to the actual vision or strategy of how to achieve sector-wide reductions goals.

To flesh out this vision, the City produced its Existing Buildings Electrification Strategy (BEBES) as a roadmap to guide City policy to decarbonize the building sector. Its four main pillars are Time of Replacement and Renovation, Time of Sale, Building Performance Standards, and Neighborhood Electrification & Gas Pruning. These pillars rest upon four principles that serve as guardrails for equity: Access to Health and Safety Benefits, Access to Economic Benefits, Maximize Ease of Installation, and Promote Housing Affordability & Anti-Displacement.

It then lays out fifty-seven specific actions to implement as part of the roadmap. While we leave the descriptions of those actions to BEBES itself, a few stand out. Building Performance Standard Strategy 5 recommends that the City:

> 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.

Fees assessed on large buildings can be incredibly effective tools for decarbonizing buildings. As we see with BESO, absent any actual impetus to reduce emissions, few building owners take action to reduce them and those that do are generally not meeting the rate needed to meet the City's climate goals. A fee would change the economics of reducing emissions such that we could achieve deeper reductions. At the same time, a fee assessed on this population to subsidize LMI multi-family buildings helps improve equity, because while building owners generally have good access to capital to finance retrofits, smaller building owners or tenants generally do not and thus need additional financial support.

In fact, Neighborhood Electrification Strategy 4 (NE4) highlights the same point:

> 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.

According to BEBES, a whopping 61% of the buildings in Berkeley are single-family homes, and an additional 30% are low-rise commercial or residential buildings.[29] The sheer number of these buildings makes a piecemeal, unsubsidized approach infeasible, particularly in under-resourced communities. A coordinated effort funded by the City is necessary to make large-scale electrification a shared reality. It also presents, as NE4 implies, an excellent opportunity to invest in our local workforce via partnerships with organized labor and the creation of high-road jobs. Per the equity guardrails, both the demand side (health) benefits and the supply side (employment) benefits should be shared by all.

BEBES's policy ideas, if implemented, can help the City achieve equitable building decarbonization. However, there is much work to be done, especially because even straightforward, long-planned policy options items like a time-of-sale retrofit requirement for single-family homes have been delayed. If the City is to meet its 2030 and 2045 decarbonization goals, it must accelerate its action.

Pilot Programs

While most of BEBES's policy proposals remain unactioned, the City has made some small investments in pilot programs that can inform future policy design in the buildings sector.

[29] https://berkeleyca.gov/sites/default/files/2022-01/Berkeley-Existing-Buildings-Electrification-Strategy.pdf

As part of the Climate Equity Pilot Program in 2021, the Council funded $250,000 in home electrification grants for income-qualified residents. Three agencies were awarded grants for labor, energy efficiency equipment, building envelope improvements, heat pump water heaters and/or heat pump air space heating/cooling, induction cooking ranges, and related work for health and safety upgrades in buildings with income-qualified residents. Grantees included:

- Association for Energy Affordability, using funds to upgrade several multifamily buildings in Berkeley that house low-to-moderate income residents.
- BlocPower, providing electrification upgrades to income-qualified, single-family homeowners in Berkeley.
- Northern California Land Trust (NCLT), working to fully decarbonize its eight-unit building at 10th Street in Berkeley.

The following year, the City created a $1.5 million Pilot Existing Building Electrification Installation Incentives and Just Transition Program. The program will utilize pre-qualified contractors meeting minimum labor standards to assist new property owners, renters and existing property owners with transition to zero-carbon plumbing, HVAC, cooking, and related electrical systems, with a preference first for assisting existing affordable housing buildings and assisting households at or below 120% of the Area Median Income.

These innovative and exciting programs will directly result in emissions reductions and have already provided important learnings for future policy design. Continued funding will ensure their impact can spread beyond a few small homes and buildings to the community at large.

Summary

The City's climate goals can only be achieved with bold policies that go beyond the status quo and directly reduce emissions. Large scale funding and implementation is necessary. In particular:

- BESO compliance has been stagnant over time at below 60%.
- BESO's public data does not indicate that buildings are on track to meet the City's climate goals. Over the last four years, energy usage relative to baseline has been stagnant or slightly increasing among reporting buildings.
- It is clear that the enforcement of BESO has to change, or additional tools need to be leveraged to ensure that Berkeley can meet local and regional climate goals.
- BEBES recommends large scale decarbonization programs funded by fees assessed on large buildings as a way to accelerate building electrification and improve equity outcomes.
- The City has a number of pilot programs that can be scaled up to help all residents and businesses in our communities.

Policy Context

There are currently two leading policies for existing building decarbonization with unique relevance to the Berkeley context. They are Building Performance Standards (BPS) and Zero NO_x Appliance Standards (Zero NO_x).

Building Performance Standards

A BPS operates by setting a statutory limit on emissions from buildings that decreases over time until reaching a long-term goal of zero emissions. Many cities across the country have adopted them, including New York, Boston, Seattle, Cambridge, Washington D.C., St. Louis, Denver, and dozens more have pledged to implement one, including Berkeley[30].

BPSes focus on buildings generally over 20,000 square feet which are responsible for a disproportionate percentage of building sector emissions. A policy that addresses such buildings can have a huge sector wide impact. In Seattle, for example, they estimate their BPS will reduce sector emissions by 27%[31].

More recent examples of performance standards have acknowledged that simple statutory mandates are insufficient without significant penalties. Cities like New York and Boston assess hefty fines for non compliance, amounting to millions of dollars. This money is then used to support electrification efforts elsewhere throughout the City[32].

A BPS in absence of additional supporting policy can generally be thought of as a market-based approach, because it typically targets a small subset of the building stock with the means to respond to a mandate, hoping that their transition will catalyze a market that will trickle-down to the rest of the community, it. In contrast, BEBES defines a “Targeted Universalism” approach as follows:

> 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.

Although the fines collected from a BPS are often allocated to other community decarbonization projects – and in the case of Boston, some money is pre-appropriated – reliance on a BPS as

---

[30] https://nationalbpscoalition.org/

[31] https://www.seattle.gov/environment/climate-change/buildings-and-energy/building-emissions-performance-standard/beps-policy-development

[32] https://www.boston.gov/departments/environment/equitable-emissions-investment-fund

an isolated policy for building decarbonization does not address and may exacerbate inequity. As large buildings decarbonize due to the mandates, smaller buildings and disadvantaged residents not only get left behind in the transition, but also are stuck with increased costs of maintaining the existing gas infrastructure for a shrinking population. In Berkeley, the inequity is likely to be even more stark, since over 90% of the buildings (and the vast majority of residents) occupy buildings that would not be covered by a BPS.

Berkeley's stated policy roadmap (from staff) begins with a single-family home time-of-sale retrofit requirement in 2024 and follows with a BPS in 2026. We believe that such an approach falls short of existing City guidelines and equity commitments.

Zero NO_x Appliance Standards

Zero NO_x appliance standards aim to reduce greenhouse gas emissions by regulating a byproduct of methane combustion – nitrogen oxides. These chemicals, in addition to themselves being a greenhouse gas, contribute heavily to pollution burdens by contributing to smog and increasing asthma risk among children. A Zero NO_x appliance standard that prevents the sale and installation of appliances that emit NO_x thus improves public health while also eliminating the climate impact of methane in buildings.

Because of the link between NO_x emissions and public health, regulatory and legislative bodies have robust authority to implement Zero NO_x rules, making them an increasingly popular option. The most notable Zero NO_x rules came from the Bay Area Air Quality Management District (BAAQMD) in 2023. Rules 9-4 and 9-6 will require any new residential water or space heaters to be Zero NO_x starting in 2027 and 2029, and some commercial water heaters starting in 2031[33].

This regulation is monumental, because it means all residential and most commercial buildings in the Bay Area will be set on a course towards zero emissions. At the same time, it only serves a backstop to more aggressive building decarbonization, since it locks in climate benefits only when space or water heating is replaced. As the typical lifespan of this equipment is ten to twenty years, the regulation's full effects will not be realized until the 2040s.

Moreover, BAAQMD acknowledged that their regulation does not address some thorny technical and equity issues, leaving those up to local municipalities. In particular, many homes throughout the Bay Area (and Berkeley in particular) have undersized electrical panels and old wiring that means they might require additional electrical work to support heat pumps. Although technological innovation will mitigate these issues somewhat, there is an immense challenge to prepare homes so that they will be ready to install heat pumps when their old equipment gives out. This technical problem doubles as an equity issue, as those homes that will require the most additional work to support heat pumps are also those homes in disadvantaged and

---

33 https://www.baaqmd.gov/~/media/dotgov/files/rules/reg-9-rule-4-nitrogen-oxides-from-fan-type-residential-central-furnaces/2021-amendments/documents/20230127_factsheet_rg09040906-pdf.pdf?rev=d9742b53163040889754f9dd0744351a&sc_lang=en

under-resourced communities. Local municipalities must step up to address this funding and preparedness gap.

The stakes for local action are high. Not only is Berkeley faced with supporting these regional regulations, but also as the California Air Resources Board (CARB) plans its own Zero NO_x regulations[34], it is incumbent on the Bay Area to show how BAAQMD's Zero NO_x rules can be a success so they can be scaled statewide.

Summary

The two most common policies for promoting building decarbonization are Building Performance Standards and Zero NO_x appliance regulations:

- BPSes set statutory emissions thresholds for large buildings and assess a fee for non-compliance.
- Zero NO_x appliance regulations prohibit the installation of new gas appliances on the basis of the negative health impacts from gas combustion, which releases NO_x.
- The traditional conceptions of BPS and Zero NO_x regulations are heavily market-based approaches, leaving funding for decarbonization to individual building owners and residents.
- BAAQMD has implemented Zero NO_x appliance rules that will phase-in over 2027-2031. CARB has indicated its intent to follow suit.
- The biggest risk to BAAQMD's regulations is a lack of local funding and support for residents to pay for and perform electrification retrofits. BAAQMD has called upon municipalities in its region to address these equity questions.

Large Buildings Fossil Fuel Emissions Tax

It is clear that the major gap in the existing building decarbonization policies is the lack of substantial, up-front funding provided to the community-at-large and disadvantaged members in particular in order to ensure the transition proceeds equitably. BEBES itself notes this, and sets as the final Phase 1 milestone (for 2025) the establishment of a "Holistic funding/financing program."

As a historical climate leader and leader in the building decarbonization space, Berkeley has an obligation both to ensure that BAAQMD's Zero NO_x rules are a success (so its impact can spread statewide via CARB) and to bring equity into the fold as an immediate, rather than long-term priority.

[34] https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/zero-emission-space-and-water-heater-standards/faq

Carbon Tax and Just Transition Fund

Our proposal is simple: assess an excise tax – a carbon tax – on emissions from methane polluters subject to BESO's annual reporting requirements (i.e. owners of buildings 15,000 square feet or larger). This tax would create a $26.7 million per year Just Transition Fund to help all residents fight climate change and improve their quality of life. Over the twenty-five years the measure would be in effect, this would raise over half of the money the City estimates is needed to electrify all low-rise buildings[35].

The tax accounts for the societal damages from burning and leaking methane gas. In doing so, the tax accomplishes two key things:

1. Provides impetus for the largest building owners to reduce or eliminate methane use and emissions; and
2. Pays for climate-friendly appliances and voluntary upgrades for homeowners, renters, restaurants businesses, including those subject to the tax. Upgrades include heat pumps, all-electric appliances, solar, battery storage, panel upgrades, wiring, EV and mobility charging, insulation, and more.

The value of the tax, which is based on the social cost of carbon and methane emissions, would increase by 6% per year, to account for the increasing damages associated with carbon emissions year over year. Put another way, the tax scales as we get closer and closer to climactic tipping points (e.g. melting ice caps, permafrost, rising ocean temperatures). The proposed increase is in line with many recent Congressional carbon tax proposals, which included 5% or 6% escalators[36][37][38].

As proposed, the Large Buildings Fossil Fuel Emissions Tax is merely an extension of existing City policy that draws on its own recommendations as well as best practices from other municipalities. In particular, it targets the same set of buildings already subject to annual energy reporting requirements from BESO, which should both minimize the overhead to collect the tax and generally provide a consistent outward stance to the community that segregates by building size. It leverages policy ideas from other municipalities as well as BEBES by assessing a penalty for emissions in order to both prompt reductions and fund programs in smaller buildings. Last, it builds on labor standards and equity principles from existing City-funded pilot programs, scaling their benefits to the entire community.

We also believe the measure should stand up to legal scrutiny, as cities in California have wide latitude on taxation. Moreover, in the Ninth Circuit Ruling striking down Berkeley's 2019 gas ban, a judge noted "local governments are likely free to impose carbon taxes designed to discourage

---

[35] https://berkeleyca.gov/sites/default/files/documents/2021-11-30%20Item%2021%20Budget%20Referral%20and%20Resolution%20Establishing%20a%20Pilot%20Existing%20Building.pdf

[36] https://www.congress.gov/bill/117th-congress/senate-bill/2085

[37] https://www.congress.gov/bill/117th-congress/house-bill/3039/text

[38] https://www.congress.gov/bill/117th-congress/house-bill/3311

such [gas] consumption.[39]" At minimum, this means the measure should be free of any challenge based on the Energy Policy and Conservation Act, however spurious its original interpretation.

Practically speaking, the main public concern voiced by the Restaurant Association and Downtown Business Association, the chief opponents of the gas ban, was that the ban limited choice. They were supportive of the climate goals of electrification, but they wanted the latitude to be able to choose whether or not to use methane gas in their buildings. The proposed measure provides choice, but requires the building owner to pay for the climate and social damages caused by that gas use.

Costs and Opportunities

The most important way this tax differs from other taxes (climate or otherwise) is that there is a clear path to reducing tax burden for parties that owe the tax. This approach is preferable to something like a gross receipts tax[40] or a flat utility tax, which is merely punitive, because it sets up a clear incentive for building owners to take an action that benefits society. Put another way: if the tax ended up collecting zero or minimal dollars because all buildings decarbonized tomorrow, the measure could be considered a success.

The practical reality is that this measure will collect revenue, which is what will enable benefits to be shared equitably, citywide. This of course means that building owners will incur costs. Our analysis suggests that the median tax is $0.58 / square foot, which is in line with existing parcel tax rates[41]. It also compares quite favorably with rents. A sample of current commercial rental listings includes[42]:

Property Type	No. of Listings	Average Asking
Office	69	$36.65
Retail	26	$29.64
Industrial	27	$19.75

The story gets better still. A key difference between a tax on natural gas use versus a blanket utility tax, a gross receipts tax, or a parcel tax is that there is a clear pathway for reducing the cost of the tax, such that both outliers (high tax paying buildings) and medians should come down over time, while generally rents or the costs of owning and operating a building will only increase due to inflation. Boston, in their Building Emissions Reporting and Disclosure

---

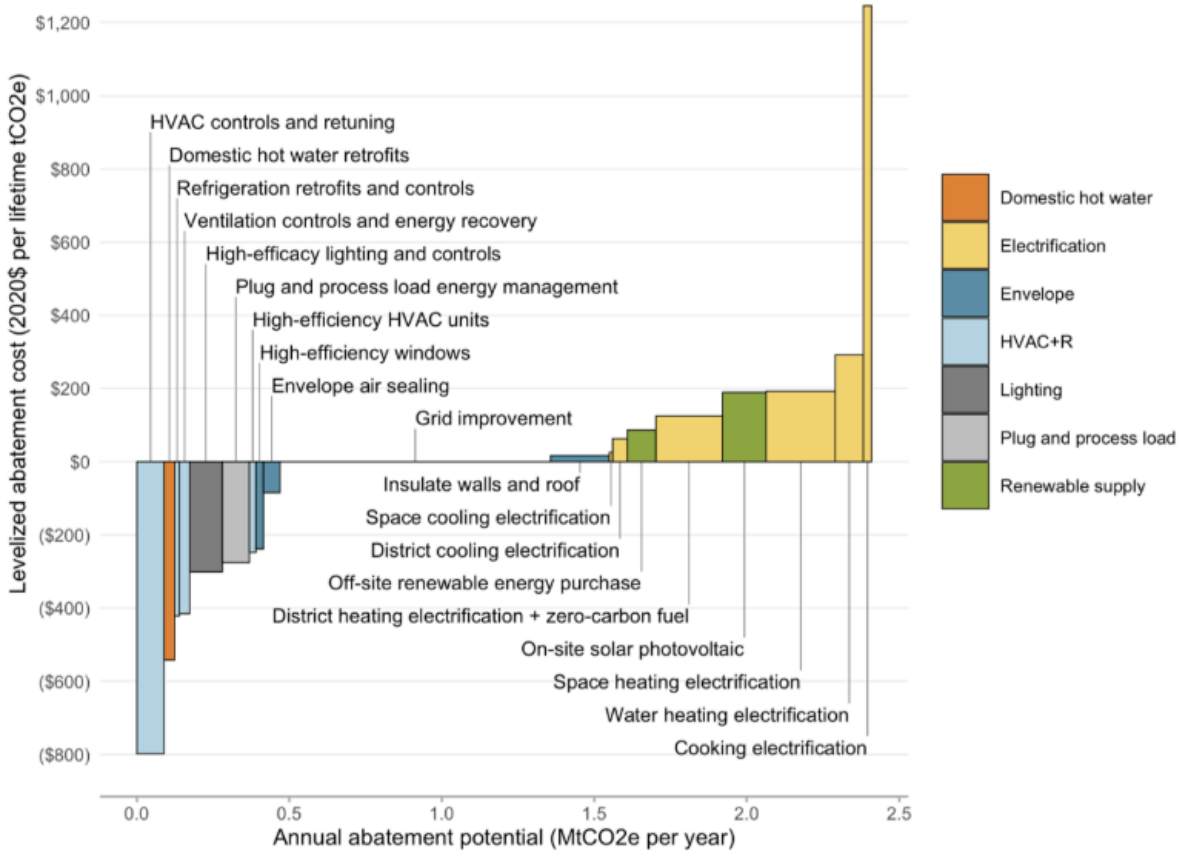
[39] https://cdn.ca9.uscourts.gov/datastore/uploads/cases-of-interest/2023/california-restaurant-association/21-16278-87-04-17-2023-Opinion.pdf

[40] https://www.portland.gov/bps/cleanenergy/faqs-about-pcef

[41] https://berkeleyca.gov/city-services/report-pay/property-taxes

[42] https://www.propertyshark.com/cre/commercial-real-estate/us/ca/berkeley/?ListingType=Lease

Ordinance (BERDO), commissioned an analysis of the various costs of these reductions as a way of conveying the feasibility of their proposal[43]:



While the exact details of the graph are not directly applicable to Berkeley due to Boston's differing climate, electric grid, and building characteristics, the general ideas remain the same. Standing purely on the economic payback of the measure, and without even considering the additional incentive of the tax, there are certain measures like building controls and appliance efficiency upgrades that save money for building owners while also reducing greenhouse gas emissions. In the worst-performing buildings, this list can also extend to building envelope upgrades, which can provide a payback of greater than 5%[44].

Moreover, in cases where utility bills are paid for by tenants (the majority of leases), measures that reduce emissions through efficiency also benefit the tenant. There are likely an abundance of no-brainer, win-win opportunities available for existing buildings, which have the added benefit of reducing tax burden, and these opportunities are highest in the least efficient buildings that are currently projected to pay the highest amount of tax. Thus, a building owner who

---

[43] https://www.boston.gov/sites/default/files/file/2021/02/Boston_Performance_Standard_Technical_Methods_2021-02-18_20-013_0.pdf

[44] https://berkeleyca.gov/sites/default/files/2022-01/Berkeley-Existing-Buildings-Electrification-Strategy.pdf

declines to perform these measures and instead complains about the amount of the tax and impact on their tenants is being politically motivated at best, and spiteful at worst.

When we get to the right-hand side of the graph, into the electrification oriented measures, we begin to see both the value of the tax and the powerful economic incentive to decarbonize that it creates. At the time of the Boston analysis in 2021, all measures except cooking electrification cost well under our proposed $382/ton of CO_2 emissions[45]. Put another way, it is likely to be substantially cheaper to decarbonize than to pay the tax year after year.

In the development of their BPS, Seattle produced cost estimates of various emissions reductions measures. The cost estimates for each measure they analyzed generally aligned with the Boston abatement cost analysis, with building controls and water conservation measures (which lower hot water usage, and thus, gas usage) costing mere pennies per square foot on the low end to electrification measures which cost between a few dollars per square foot and tens of dollars[46]. After incorporating various rebates and incentives and the value of our proposed tax, substantial emissions reductions opportunities will be available with a fairly short payback period.

Additionally, Berkeley's building stock in some ways lends itself to more straightforward electrification than other larger cities that have established large building decarbonization policies. Many of the technical complexities of the largest buildings that drive cost will be the exception, rather than the norm, because the majority of the buildings subject to the tax are below 50,000 square feet in size (commonly characterized as "medium-sized" buildings). Multiple analyses on the technical and cost feasibility of commercial building electrification indicate that for small-to-medium sized buildings, packaged, all-electric heating and cooling solutions can often be swapped out for their natural gas consuming counterparts with minimal additional work required[47][48]. The ability to use off-the-shelf solutions compatible with existing building HVAC structures presents a tremendous opportunity for near-term emissions (and thus, tax) reductions.

Summary

A Large Fossil Fuel Emissions Tax is a compelling approach to tackling city-wide building decarbonization:

- The tax, based on the social costs of carbon and methane, is an economically efficient way to incentivize a transition to zero-emissions building equipment.
- The funds, estimated at $26.7 million in the first year, would be made immediately available to any resident or business across the City who wishes to electrify their homes.

[45] This ignores the methane leakage fee, which raises the effective tax rate further.
[46] https://www.seattle.gov/documents/Departments/OSE/Building%20Energy/OSE_Decarbonization_Cost%20Study_June22.pdf
[47] https://rmi.org/insight/economics-of-electrifying-buildings-medium-size-commercial-retrofits/
[48] https://www.redwoodenergy.net/research/redwood-energys-pocket-guide-to-all-electric-commercial-retrofits

- The tax has a strong equity foundation, building on existing City pilot programs and policy, protecting renters, and prioritizing environmental justice communities.
- It will catalyze a local just transition through its focus on large-scale projects and strong labor standards.
- Net costs imposed by the tax on building owners compare favorably to existing rents, with the median around 2%.
- The annual increase in tax rate of 6% is in line with numerous federal carbon tax proposals introduced in the previous Congress.
- There are substantial opportunities for easy and immediate reductions in emissions that save both owners and tenants money, even before accounting for the avoided tax.

Conclusion

Amid an accelerating climate crisis and an uncertain regulatory environment, Berkeley has an opportunity to take climate action that will align with its goals and improve the health and wellbeing of its residents. This action is best taken through a carbon tax on the leaky, noxious, climate-warming methane currently used in buildings.

This tax will fill many gaps present in existing city policies, which do not raise adequate funding for large scale emissions reductions and do not prompt buildings to decarbonize rapidly. The tax will lead to faster decarbonization than other policy options used in other cities such as BPSes or Zero NO_x regulations. The funds raised by this tax are available to all homes and businesses in Berkeley, including those who pay into the fund, to remove fossil fuel infrastructure from their buildings and replace them with heat pumps, electric ranges, battery storage, solar, and other technologies. This tax satisfies both regional and local needs: regionally, Berkeley needs to raise funding to comply with upcoming BAAQMD regulations in an equitable manner; locally, this tax provides businesses with requested flexibility to continue to use gas if desired. Renters are protected, union labor is prioritized, and the tax is strongly rooted in an economic understanding of the damaging effects of methane; all fact-based, humanistic values that are quintessentially Berkeley.

Some may say that a bold step taken by a humble city of 136,000 could not make a difference, or could not matter to the overall climate crisis. We believe they could not matter more. When Berkeley passed our first-in-the-nation gas ban in 2019, tens of municipalities across the country followed suit, including San Francisco and New York. Many of the municipalities are continuing to enforce their bans despite the ruling that overturned Berkeley's. Our efforts to improve our city ripple out to inspire other policy makers, climate organizers, and motivated citizens. It's time to get to work.