City of Emeryville
CALIFORNIA

M E M O R A N D U M

DATE: March 2, 2021

TO: Christine Daniel, City Manager

FROM: Mary Grace Houlihan, Public Works Director

SUBJECT: **Consideration Of Energy And Building Reach Codes**

RECOMMENDATION

At the request of the Sustainability Committee, staff recommends the City Council consider the proposed energy and building material reach codes and provide staff direction whether to prepare an amendment to the City Building Ordinance during the 2019 Building code cycle. These amendments will help reduce carbon emissions and reduce costs associated with new construction and major renovations, improve indoor air quality, safety, and resiliency of our building stock, and support affordable housing.

This recommendation requires modifying Part 6 and Part 11 of the California Building Code (Title 24), which are adopted in the Emeryville Municipal Code as Chapter 10 (Energy Code) of Title 8, and Chapter 8 (Green Building Standards Code) of Title 8, respectively. This report provides an overview of the statewide cost-effectiveness study for the energy elements as required by the California Energy Commission (CEC), details relevant findings, and provides language for consideration for reach codes to be adopted mid-cycle of the 2019 building codes.

This report focuses on energy requirements and building materials. Electric vehicle infrastructure is another important element of greenhouse gas (GHG) reduction, but that has been addressed recently in Emeryville's Planning Regulations, and so is not included in these recommendations.

BACKGROUND

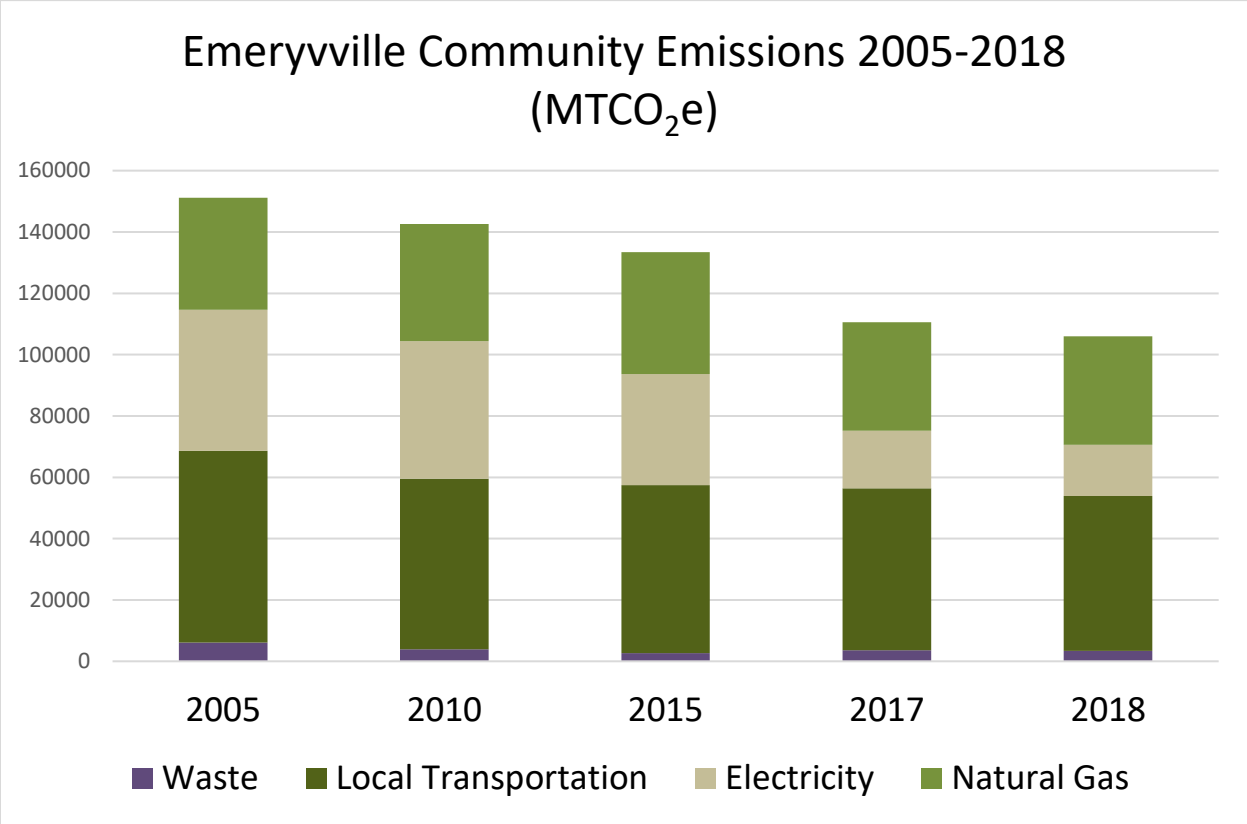
The City of Emeryville is among hundreds of municipalities, states, and countries worldwide that have committed to efforts to reduce GHG emissions (which are often expressed in carbon equivalents; the terms GHG and 'carbon' both describe these emissions). Emeryville is a signatory to the Global Covenant of Mayors, a group that grew out of the Paris Climate Accords to work together to achieve the goals of those Accords.

In addition, the state of California has a goal of a 40% reduction in GHG emissions over baseline levels by 2030, and a target of an 80% reduction by 2050. The goals in Emeryville's 2016 Climate Action Plan 2.0 mirror these state goals. In addition, Executive Order B-55-18 goes further, committing California to economy-wide carbon neutrality by 2045[1]. Thirty-four percent of Emeryville's community-wide emissions come from building operations, and buildings built today will be in use far past the 2045 and 2050 target dates

[1] https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf

for GHGs. The impact of the embodied carbon in new buildings is not captured in these numbers, although it is considered to be a significant source of uncounted emissions.

All values in metric tonnes CO_2 equivalent ($MTCO_2e$)



Reach Code Adoption Process

Every three years, the State of California adopts new building standards that are organized in Title 24 of the California Code of Regulations, referred to as the California Building Standards Code. This regular update is referred to as a "code cycle." The last code cycle was adopted in 2019 and became effective January 1, 2020. Cities and counties can adopt reach codes at any time during a code cycle that include requirements that are above the minimum state code requirements. However in order to adopt local amendments that are more restrictive than the minimum standards of the state code, the local jurisdiction must make findings that the proposed changes are reasonably necessary because of local climatic, geologic, or topographical conditions[2]. Local seasonal climactic conditions, exacerbated by climate change, present the risk of higher-intensity winter storms and sea level rise, threatening critical infrastructure in Emeryville, along with increased fire risk in hotter dry seasons. Regarding geologic conditions, because Emeryville is located in proximity to the Hayward and San Andreas Faults, the City has an increased risk of fires caused by breaks in natural gas lines during seismic activity. Reducing the reliance on natural gas in new construction will decrease the risk of fires caused when gas lines rupture or break in seismic-related events. Decreasing

[2] Health & Safety Code sections 17958.5, 17958.7, 18941.5

GHG emissions can mitigate climate change. The topology of Emeryville, with its San Francisco Bay shoreline, makes it vulnerable to climate-caused sea level rise and associated risk to key transportation and other infrastructure.

In addition, the California Energy Commission (CEC) requires that a cost-effectiveness study be conducted and filed in the case of local amendments to the Energy Code (Title 24, Part 6). It is required that the City demonstrate to the CEC, using a cost-effectiveness study, that the amendments to the code are financially responsible and do not represent an unreasonable burden to the non-residential and residential applicants. A cost-effectiveness study is not required for amendments to the Green Building Standards Code (Title 24, Part 11).

DISCUSSION

Reach Code Proposals for Discussion

Energy Codes

GHGs cannot be removed from natural gas, and the impact of natural gas production, distribution and use is a major contributor to GHG emissions everywhere it is used. Conversely, our electric grid is capable of delivering GHG-free electricity. Given the large impact that natural gas has on GHG emissions, along with the indoor air hazards and the community safety risks associated with natural gas infrastructure,[3] a switch away from natural gas is a critical step in reducing GHG emissions and climate impact longer-term. Buildings constructed in 2022 are expected to be in use well beyond 2045, the State of California's target date for carbon neutrality.

As shown in the data above, natural gas use in buildings is one of the largest sources of GHG emissions in Emeryville. In most building uses, natural gas can be replaced with electric power in a cost-effective way, with no loss of function. The state's electric system is rapidly becoming cleaner, driven by escalating renewable portfolio standards and cleaner product offerings by the utilities and community choice aggregators (CCAs) including East Bay Community Energy (EBCE), which offers a 100% renewable, GHG-free electricity option for residents and businesses in Emeryville.

In addition, advances in electric heat pumps and other electrical equipment are yielding much higher overall efficiencies than their natural gas counterparts. Electric heat pumps, unlike traditional electric resistance heaters, do not generate heat, but concentrate and transfer it for end uses such as space conditioning and water heating. This process uses less primary energy and emits much less carbon, particularly when it is powered by renewable energy.

Health Impacts of Natural Gas Appliances

[3] https://www.nrdc.org/experts/amy-mall/pipeline-incident-statistics-reveal-significant-dangers

Fossil fuel use creates both indoor and outdoor air quality concerns. A study released in April 2020 by the UCLA Fielding School of Public Health made the following findings[4]:

Indoor Air Quality

- Gas appliances emit a wide range of air pollutants, such as carbon monoxide (CO), nitrogen oxides (NOx, including nitrogen dioxide (NO2)), particulate matter (PM), and formaldehyde, which have been linked to various acute and chronic health effects, including respiratory illness, cardiovascular disease, and premature death.

- Under a hypothetical cooking scenario where a stove and oven are used simultaneously for one hour, peak concentrations of NO2 from cooking with gas appliances exceed the levels of acute national and California-based ambient air quality thresholds in more than 90% of modeled emission scenarios.

- Concentrations of CO and NO2 resulting from gas cooking are the highest for apartments, due to a smaller residence size. This presents an additional risk for renters, who are often low-income.

- Increases in indoor air pollutant concentrations can be driven by insufficient ventilation. Surveys show that fewer than 35% of California residents use range hoods when cooking — and many homes in the U.S. are lacking range hoods or ventilation altogether.

- The use of kitchen appliances for supplemental heating can increase exposure risks, and there is evidence this disproportionately affects low-income households, though more data on the frequency of use is needed to quantify the risk to various populations.

- Environmental justice communities disproportionately experience poor housing conditions which can be detrimental to health. Concerns related to gas appliance use include: the presence of old and unmaintained appliances in households, smaller and overcrowded residences where air pollution can reach higher concentrations, and challenges faced by renters to control appliance choices or afford maintenance. These populations already face cumulative effects associated with health and environmental injustices more broadly, and gas appliance issues can compound this. There are significant data gaps regarding equity and the health effects of gas combustion on low-income and minority populations, which should be further explored to facilitate a just transition to a low-carbon future.

- Better regulations and safeguards are needed to protect residents from exposure to indoor air pollution from gas appliances. Along with replacing gas kitchen appliances with electric alternatives, increasing the frequency of range hood use and improving the efficacy of ventilation technology would also reduce exposure and protect public health.

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

Outdoor Air Quality

- Gas appliances are also a source of outdoor air pollution, and literature shows that the pollutants released by combustion can lead to illness and premature death.

- The UCLA study found that approximately 12,000 tons of CO and 15,900 tons of NOX were emitted to outdoor air from the use of residential gas appliances in California in 2018.

- If all residential gas appliances were immediately replaced with clean electric alternatives, the reduction of outdoor NOX and PM2.5 would result in 354 fewer deaths, as well as 596 fewer cases of acute bronchitis and 304 fewer cases of chronic bronchitis annually in California. This is equivalent to approximately $3.5 billion in monetized health benefits over the course of one year. These numbers only account for exposures from outdoor air as a result of residential electrification; a full exposure assessment accounting for indoor exposures would increase the total health benefits and the associated economic benefits of residential electrification.

Technology is available and cost-effective to move faster on achieving these climate and health goals. For these reasons and others, many cities have adopted or are considering adopting similar measures. Exhibit A is a current list of California cities' reach code efforts and progress.

Recommended Reach Codes - Energy

<u>New Construction</u>
With an eye toward both the City's and the State's goals for GHG reductions, the Sustainability Committee is recommending that City Council adopt "reach codes" to require certain cost-effective measures in new construction. With the understanding that there are some commercial uses of natural gas which do not yet have proven, cost-effective electric equivalents, the Sustainability Committee is recommending that all new construction meet the following requirements:

1) New construction of low-rise and high-rise residential occupancies must be all-electric, meeting current energy code requirements. No mixed-fuel pathway would be allowed except for:
    a. Free-standing Accessory Dwelling Units smaller than 400 square feet
    b. Projects that have been received a Planning Permit, or Zoning Compliance Review prior to the effective date of the ordinance adopting reach codes. Projects which do not require planning approval, and for which a building permit application has been filed prior to the effective date of the ordinance adopting reach codes.
    c. Projects demonstrating practical infeasibility, subject to Building Official approval

    Where exemptions apply, wiring or conduit would be required to enable future electrification.

2) For nonresidential occupancies, two pathways are offered:
    a. All-electric construction meeting current energy code requirements; or
    b. Mixed-fuel construction subject to the following additional requirements:
        i. All-electric readiness, meaning the inclusion of electrical infrastructure to enable a future discontinuation of fuel gas[5] use[6]
        ii. Improved energy efficiency[7]

In new residential construction, no natural gas infrastructure or use would be permitted.

The all-electric readiness requirements are designed to enable buildings initially equipped with natural gas appliances to replace them with electric appliances at a later time without having to make electrical capacity upgrades or make other changes to the building. The all-electric readiness requirements are based on findings in studies funded by the California Public Utilities Commission (Exhibits B, C and D) that all-electric buildings cause fewer GHG emissions. There are no cost-effectiveness findings for these provisions since, by themselves, they do not reduce energy. Including these is prudent as they are relatively inexpensive at the time of initial construction while enabling buildings to avoid much higher conversion costs in the future.

- **Recommend additional requirements for installation of solar panels/photovoltaic systems (PV).** PV installation is currently required for new residential construction up to three stories, and PV-ready construction is currently required for projects up to ten stories[8]. The recommended code would require solar PV installation on the entire solar zone defined as “an allocated space that is unshaded, unpenetrated, and free of obstructions” and “a suitable place that solar panels can be installed…,”in 24 CCR 6 § 110.10 (b).

<u>Existing Buildings</u>

- **Require the installation of an electric space-conditioning system as the only source of heating** if a new or replacement vapor-compression air conditioning is installed.[9] This would apply to residential, retail, and office buildings. Office buildings would also be required to install solar panels generating two Watts per square foot (2 W/ft^2) of conditioned floor area.

- **Require electrification-ready panel installation when panel is replaced**, except where the panel may result in requiring a service connection upgrade.

[5] “Fuel gas” is used here to describe any plumbed fuel gas; the regulations are not limited to natural gas.
[6] Electric-ready construction includes sufficient panel size and appropriate conduit and wiring to all fuel gas appliances in mixed-fuel construction. It does not require the additional electric service at initial construction.
[7] The mixed-fuel project must exceed the energy efficiency requirements of the Energy Code by 15% for office and retail buildings, and 6% for all other building types including mixed-use and hotels/motels. or meet a set of prescriptive requirements in place of these performance thresholds.
[8] https://ww2.energy.ca.gov/2015publications/CEC-400-2015-033/chapters/chapter_09_solar_ready.pdf
[9] https://drive.google.com/file/d/14_I8Yj4BynOKLa4Qfs1bVvZFaeC0iNFC/view

Building Appliance Electrification
For multiple reasons including health, safety, economics, and environmental benefits, there is considerable interest in mandating all-electric new construction, or "building electrification," which means that the buildings would not have any fossil fuel services. All-electric buildings have electric appliances for space heating, water heating, clothes-drying, and cooking. The interest in building electrification stems from the fact that East Bay Community Energy is providing 85% - 100% GHG-free electricity and eliminating the use of natural gas can greatly reduce GHG emissions from the building sector.

The use of natural gas inside the home also presents potentially serious health impacts described above.

Statewide Cost-Effectiveness Study for Energy Code Reach Codes
Funded by the California investor-owned utilities (IOUs), the California Statewide Codes and Standards Program (Statewide Program) led the development of a cost-effectiveness study for Energy Code reach codes that examined different performance-based approaches for new construction of specific building types (Exhibits B, C and D). There are two kinds of reach code approaches: performance-based ordinances and prescriptive ordinances. Performance-based ordinances mandate an increase in the overall energy efficiency required but leave flexibility on how to achieve this goal. In contrast, prescriptive ordinances mandate implementation of a specific measure (such as solar panels or cool roofs). The Statewide Program's analysis focused on performance-based ordinances but some conclusions about prescriptive measures can be made from the results.

Building Prototypes
The Statewide Program's analysis estimated cost-effectiveness of several building prototypes including one-story and two-story single-family homes, a two-story multifamily building, a five-story multifamily building, a three-story office building, a one-story retail building, and a four-story hotel. These prototypes are directly applicable to Emeryville development.

Statewide Study Findings

Building Appliance Electrification Reach Codes:
Staff have worked closely with EBCE's consultants to interpret the study's results and infer what options may or may not be cost-effective for the building types that are prevalent in the City of Emeryville, but were not analyzed by the team. EBCE has also provided consultant support to assist cities in understanding the cost-effectiveness study results and adopting reach codes. The proposed reach codes meet the requirements of the CEC for cost-effectiveness, and are also a cost-effective approach for constituents, contractors, and developers pursuing new construction within the city limits. In addition, the analysis results show that all-electric buildings are typically less expensive to construct. Costs include incremental capital costs, and, in some cases higher energy costs. In general, the first costs of an all-electric building are lower than a mixed-fuel building due to the lack of gas plumbing.

Environmental Impacts

The studies find that all-electric buildings, even those with no other energy performance enhancements, provide significant GHG reductions. The addition of energy efficiency and more solar can drive net energy use to nearly zero from some building types and GHG emissions to less than a third of a mixed-fuel 2019 State code compliant building. The chart below compares the total GHG emissions and net energy consumption (after onsite generation) of the single-family home using estimated emissions from PG&E. Results are similar for other building types.

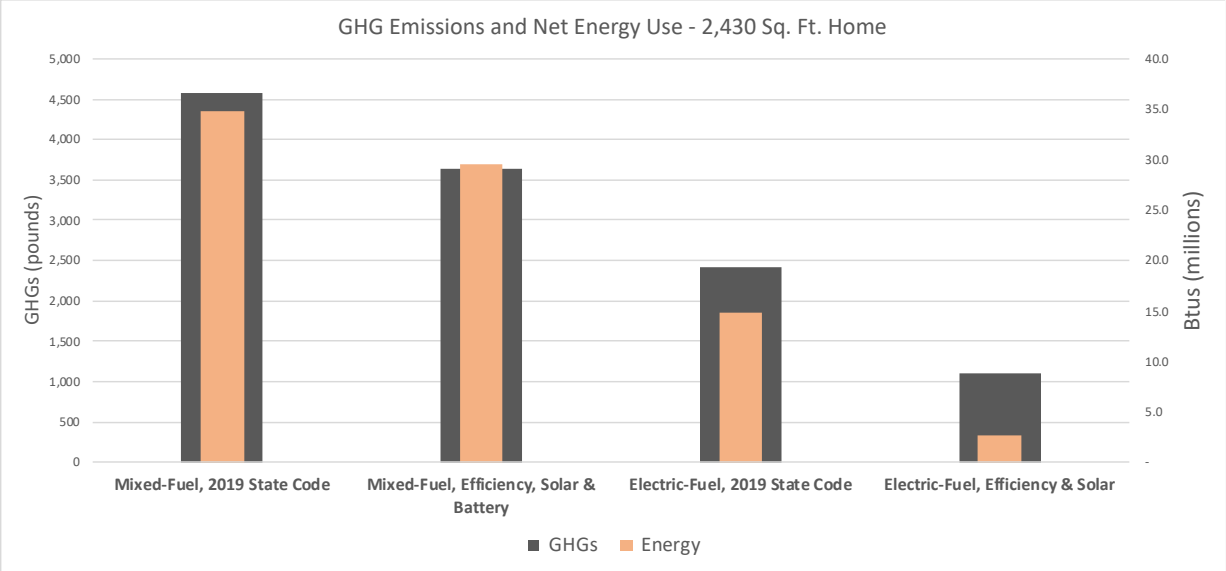


Figure 1: GHG and Energy Impact, Single Family Home

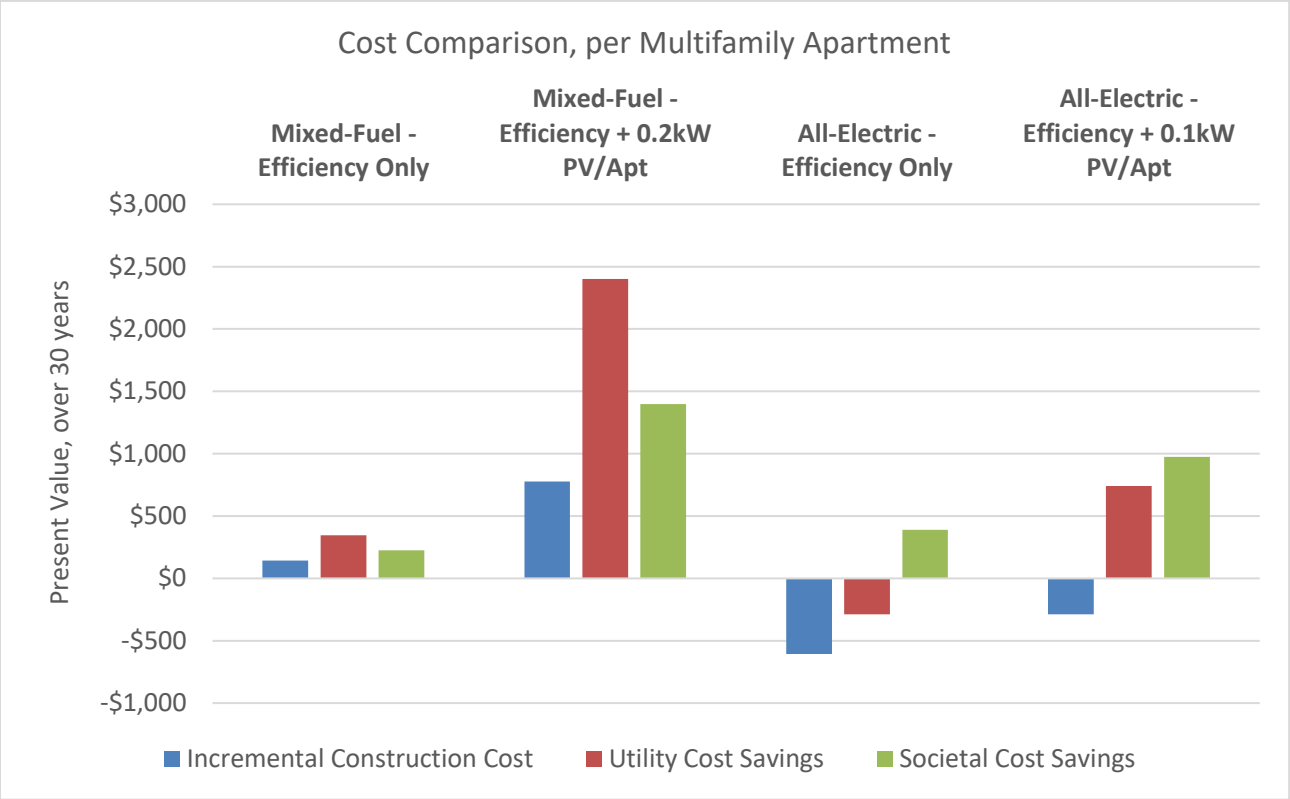
Electrification will reduce emissions even further for customers who procure power from EBCE, which currently serves a minimum of 86 percent carbon free electricity.

Economic Impacts

All-electric buildings are generally cheaper to build due to the elimination of running expensive gas plumbing to the building. These lower first costs generally make all-electric construction more cost-effective on a life-cycle basis. This is particularly true for low-rise residential buildings, where it is also often increasingly more cost-effective for the owner to exceed the code by improving efficiency and adding solar. In fact, if one invests the savings from the gas infrastructure in additional PV capacity to offset more of the electricity load, in many cases the building is cost-effective for the owner and society from day one, meaning the building is both less expensive to build and cheaper to operate.

The charts below depict the incremental net present value of incremental construction costs and savings of various designs of the five-story multifamily building relative to a State-code-complaint mixed-fuel design. The analysis examines cost effectiveness from two perspectives: one from the owners/operator's point of view; the other from society's point of view. The latter reflects benefits that accrue to other ratepayers and society. Cost values less than zero indicate lower capital cost; savings values less than zero indicate higher energy costs.

The chart shows that the all-electric building has negative incremental construction costs compared to a mixed-fuel building. These negative costs are greater than the negative savings (bill increases) that the All-Electric – Efficiency only building would experience. However, on-bill savings are achieved when including solar PV as proposed by staff. Findings are similar for all of the other building types examined in the cost effectiveness studies thus far.



Resilience and Electrification

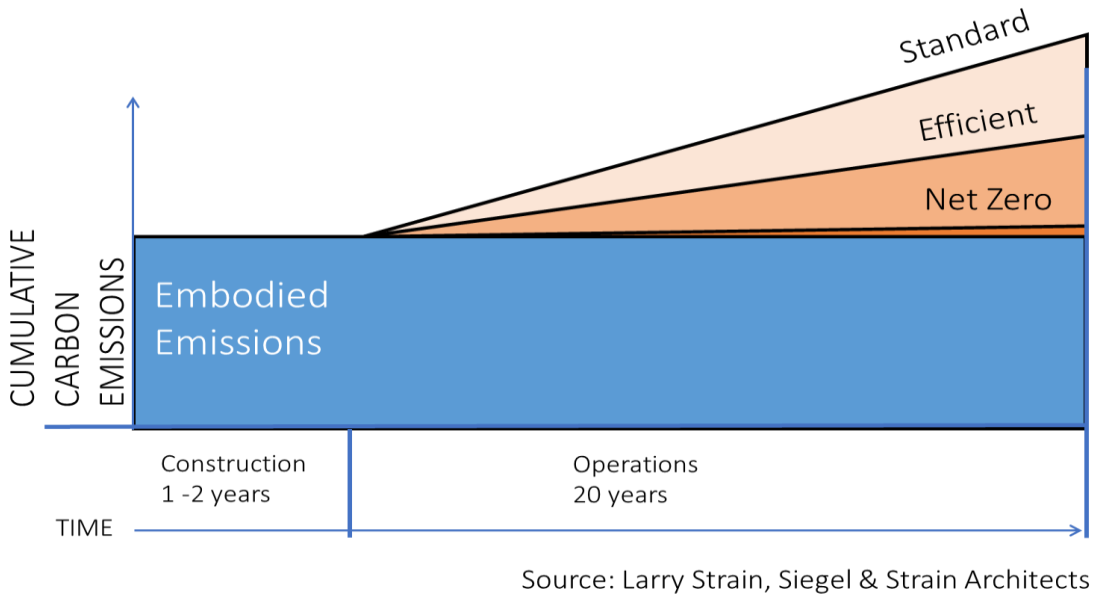
With widespread wildfires and Public Safety Power Shutoffs common and expected to continue, resiliency is a critical concern in energy production, distribution, and use. There is some sentiment among the public that natural gas appliances may be more reliable than electric appliances in this new reality, but research finds that there are circumstances that favor electric power even in these conditions.

- New water heaters, stoves and heaters all have electric ignitions since pilot lights are no longer legal. As a result, they do not work when the electricity is off regardless of their primary fuel source.
- Gas stoves can sometimes be lit with a match during a power outage; however, the exhaust fan will not work making the stove unsafe to operate.
- All-electric appliances can easily be set up to use a backup power source including generators or solar-powered batteries.
- Heat pump water heaters, like other tank-style water heaters hold substantial amounts of hot water, ready to use in case of service disruption.

- Gas negatively impacts disaster recovery time. Not only are gas lines and leaks a dangerous liability during fires, but gas service typically takes longer to become operational again after a safety shutoff or disaster-related inspection and repair, compared to electricity.

Recommended Reach Codes - Building Materials

Building materials contain embodied or embedded GHG emissions, which are the emissions generated by making and transporting materials to a building site, including mining, refining, and shipping. These embodied emissions are a very large proportion of a building's lifetime GHG contribution.



Source: Larry Strain, Siegel & Strain Architects

- **Require the use of low-carbon concrete in new construction**

Cement use in concrete is the largest single material source of embodied emissions in buildings and is responsible for an estimated 8% of total global GHG emissions, from all sectors. Replacing cement with currently available alternative cementitious materials, such as fly ash or slag, and adopting other practices to "decarbonize" concrete, has the potential of reducing the total emissions from concrete by more than half.

The Bay Area is a leader in the effort to adopt low-carbon concrete standards. Two of our neighboring jurisdictions have addressed this need in two different ways.
The City of Berkeley adopted a low-carbon concrete standard that requires that the concrete mix contains 25% supplemental cementitious materials other than cement. Typical replacement materials are fly ash or slag. The advantage of this approach is that

it is based on the CALGreen Tier 2 requirements[10] and the PCI Mix Design Handbook[11]. No additional forms are needed; the specs are noted on the plans, and documentation of the mix is shown to the building inspector at the time of construction.

The County of Marin[12] has taken the approach of regulating the embodied carbon of the project rather than the specifics of the concrete mix. The advantages of this approach include:

- Requiring the use of supplemental cementitious materials does not necessarily equate to a reduction in cement
- The mix requirements are not sensitive to requirements for strength or curing speed
- This pathway allows the use of Energy Design Rating points to achieve compliance, with the potential for more innovative technology (e.g., carbon curing, carbon sequestration through aggregate)
- This method can be scaled for project size, allowing some elements of the project to offset others (e.g., permitting a higher-carbon concrete where initial strength is needed, and offsetting with lower-carbon mix or other technology elsewhere in the project)

Staff are recommending the Marin County approach.

- **Incentivize CLT/Mass Timber in lieu of steel and concrete construction (future consideration).**

Cross-Laminated Timber (CLT), also called Mass Timber, is a large-scale, prefabricated, solid engineered wood product. It consists of several layers of kiln-dried lumber boards stacked in alternating directions, bonded with structural adhesives, and pressed to form a solid, straight, rectangular panel. It has greater fire resistance than non-engineered wood, and as a renewable material, it has the potential to sequester carbon if forest management practices are well regulated.

CLT is a relatively light material, enabling buildings to be built with smaller foundations and with lighter construction equipment, both advantages to infill construction.

CLT is currently allowable for buildings up to five stories through the Alternative Means and Methods of Construction provisions of California Building Code. The International Building Code (IBC) has approved provisions allowing for the construction of CLT buildings up to 18 stories; these will be in place in the 2021 edition of the IBC. California Code will include the IBC provisions in its 2019 Code Mid-Cycle Update, in July, 2021. Therefore, no reach code for CLT is recommended at this time.

[10] https://www.dgs.ca.gov/BSC/Resources/Page-Content/Building-Standards-Commission-Resources-List-Folder/CALGreen

[11] https://www.pci.org/PCI_Docs/Design_Resources/Misc/PCI-SDP.pdf

[12] https://www.marincounty.org/depts/cd/divisions/sustainability/low-carbon-concrete-project

Ordinance Development Process

The proposed scope of a reach code ordinance for Emeryville is similar to the approach other local governments are considering or have adopted (see Exhibit A). It is based in part on a model ordinance developed through a collaborative effort involving the City of Emeryville, California Energy Commission, the State's major utilities, several community choice aggregators including EBCE, and representatives from local governments and energy policy agencies (notably StopWaste), as well as input from staff in many local and California-wide jurisdictions.

Staff proposes that the reach codes would apply to any project for which a building permit is issued after the reach codes' effective date, with some exceptions for projects that have been in the development pipeline already and have received Planning approvals as further described below. Given the lengthy process for obtaining development approvals, coupled with the related process of obtaining construction financing, staff recommends incorporating some limited term exceptions to the application of these new reach codes for projects that are effectively already underway in Emeryville. Staff also recommends an exception for small Accessory Dwelling Units in light of the policy to support construction of that additional type of housing. Staff proposes to include the following limited exceptions to the application of the new codes:

- Projects for which a Planning Permit, as defined in the Planning Regulations at Section 9-8.216(y) of Title 9 of the EMC, has been approved prior to the effective date of the ordinance.
- Projects for which a Zoning Compliance Review, as defined in the Planning Regulations at Section 9-8.226(e) of Title 9 of the EMC, has been approved prior to the effective date of the ordinance.
- Projects which do not require planning approval, and for which a building permit application has been filed prior to the effective date of the ordinance.
- Projects demonstrating practical infeasibility, subject to Building Official approval
- Free-standing Accessory Dwelling Units smaller than 400 square feet

FISCAL IMPACT

The energy performance amendments parallel the structure and terms of the State code and as such any incremental plan check and inspection time should be minimal. The electric readiness provisions will require plan checkers and inspectors to apply additional check lists to mixed-fuel buildings. Any incremental costs of administering these requirements will be covered through existing permit fees.

STAFF COMMUNICATION WITH THE PUBLIC

These proposals have been discussed at meetings of the Sustainability Committee including on November 9, 2020, in a November 18, 2019 City Council Study Session, and in a widely publicized informational webinar held on October 19, 2020.

CONCLUSION

In response to the current climate crisis and with an awareness of the long lifespan of the built environment, it is economically and socially prudent to address embodied and operational GHG emissions of buildings as early as possible. The requirements described here could benefit builders, occupants, and the community for decades to come.

PREPARED BY: Nancy Humphrey, Environmental Programs Supervisor

APPROVED AND FORWARDED TO THE CITY COUNCIL OF THE CITY OF EMERYVILLE:

Christine Daniel, City Manager

ATTACHMENTS

- Exhibit A: List of Cities' Reach Codes
- Exhibit B: 2019 Nonresidential New Construction Reach Code Cost Effectiveness Study
- Exhibit C: 2019 Cost-effectiveness Study: Low-Rise Residential New Construction
- Exhibit D: 2019 Mid-Rise New Construction Reach Code Cost-Effectiveness Study