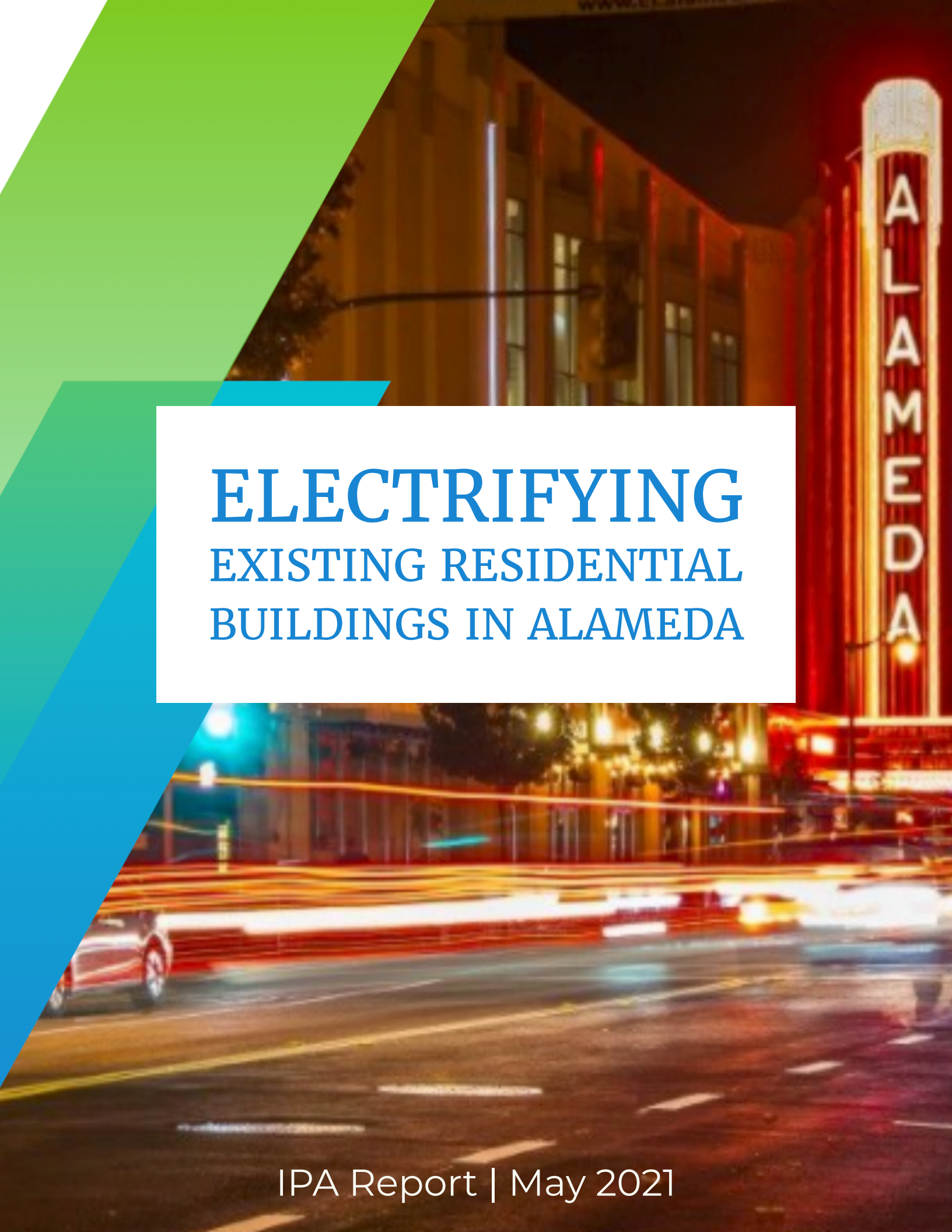

ELECTRIFYING
EXISTING RESIDENTIAL BUILDINGS IN ALAMEDA

IPA Report | May 2021

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I. Executive Summary

This report, drafted and compiled by Goldman School of Public Policy students Youngsun Choi, Zachary Zimmerman, and Jane Sadler, provides a guide to existing residential building decarbonization for Community Action for a Sustainable Alameda (CASA) and the City of Alameda. The goals of this report are to provide insights into the character of the existing residential building stock in Alameda, analyze decarbonization strategies, and provide recommendations for the most cost-efficient and expedient decarbonization strategies for the city. Special attention is paid to the equitability and cost-effectiveness of decarbonization, as well as the most effective points of intervention.

In order to meet these goals, we undertook a four-part analytical method, divided into qualitative and quantitative approaches. On the qualitative side, a relevant literature review helped us compile an extensive list of technical decarbonization and weatherization methods as well as potential points of policy intervention. Case studies into Berkeley, Piedmont, and Santa Monica, as well as into Sacramento Municipal Utility District, and Inclusive Financing schemes provided a diverse array of financing options for decarbonization for us to analyze. On the quantitative side, data from the Alameda County Tax Assessor allowed us to summarize the size, age, and type of buildings that Alameda residents live in, while Alameda transfer tax and Alameda construction permitting data gave us insight into the rollover and remodel rate of those homes. Finally, the Frontier 2019 Cost-Effectiveness Study on electrification and weatherization gave us the data necessary to conduct carbon reduction estimates.

The results of these methods will prove foundational to decarbonization work in Alameda. The takeaways of the literature review include over twenty actions that building owners can take to either electrify or weatherize their building, and the case studies provided templates for citywide decarbonization efforts. The housing stock analysis also came back with very interesting numbers. We found that there are 18,868 buildings in Alameda, of which 17,470 (92.5 percent) are residential buildings and around 86 percent of those buildings are single family residences. Despite a majority of the buildings being single family residences, when unit numbers are calculated, there are 14,697 total units in multifamily buildings. This totals about 29,785 total housing units in Alameda. Furthermore, almost 70 percent of the residential buildings in Alameda were built before 1978, which is the vintage that gains the most from electrification. Transfer tax data from July 2017 until June 2019 give us an estimate of about 165 sales per month or 1989 sales per year. Finally, permitting data from 2019 and 2020 showed that there are about 781 permits issued per year for single family homes, with the median permit value at $6000.

These analyses allowed us to make a suite of recommendations for CASA and the City of Alameda's decarbonization plan. We recommend that at the point of sale of a home, energy audits are required for both single family and multifamily homes, panel upgrades are required for single family homes, and a refundable electrification and weatherization tax is levied on the new owner. At the point of permit we recommend a split fee structure between electric gas-related projects and electricity projects, mandatory efficiency projects at a certain dollar amount of renovation, and mandatory efficiency projects and panel upgrades when photovoltaic systems, electric vehicle chargers, or air conditioning units are installed. Finally, we recommend education and outreach programs on electrification to educate the residents of Alameda so that appliances are replaced with more efficient versions at the point of burnout. In order to pay for these programs as well as other crucial decarbonization elements, we recommend a split utility user tax benefitting electricity use and penalizing natural gas use, inclusive financing options provided by Alameda Municipal Power for families who want to

electrify or weatherize, and an expanded rebate program on electrification and efficiency projects.

Finally, we organized these recommendations into three phases. Phase one focuses on education and outreach as well as information availability and expansion of existing programs. Phase two covers many of the more challenging points of intervention, and phase three on the final natural gas holdouts. Once all three phases are completed, Alameda buildings will be officially carbon-free.

II. Project Background

In the past 12 years, the City of Alameda has had great success implementing its Local Action Plan for Climate Protection. The City achieved emission reductions of 23 percent below 2005 levels this year and the municipal power provider delivers 100 percent clean energy to residents. The City of Alameda is taking another step by setting the goal of reducing emissions by 50 percent below 2005 levels by the year 2030. It passed an ordinance requiring all city-owned lands to be 100 percent electric in November 2019 and is expected to pass a second ordinance requiring all new developments within the city to be 100 percent electric as well–leaving just existing structures to decarbonize. These existing buildings pose a variety of challenges in decarbonization both in terms of structural issues–many Alameda homes are older, energy-inefficient buildings and already have natural gas hookups–as well as incentivization problems of switching from gas to electric–electricity bills are typically paid by renters and tenants instead of the building owner, and most of the city is served by a public utility that keeps energy prices low.

In order to bring the emission levels of existing buildings in conformity with the rest of the city, Alameda will have to transition the current housing stock to 100 percent electric and incentivize or mandate efficiency improvements. Alameda Municipal Power does provide 100 percent clean energy to all customers. However, there are still low rates of fuel-switching (approximately 1 percent of appliances each year) within existing buildings, due to a variety of financial, informational, climate, and cultural factors.

The City needs to determine the incentives or penalty mechanisms that will encourage homeowners and landlords to transition to all-electric, how the city can support the transition, what technologies or programs may be needed, and when to require the energy efficiency measures to be implemented.

Work has already been done on this effort. In 2019, Frontier Energy and Misti Bruceri & Associates LLC prepared an energy report for Alameda for the Codes and Standards Program Representative at PG&E. This report is a foundational document to all subsequent electrification policies in Alameda and laid the groundwork for this report. Last year, the Summer 2020 Intern for CASA developed a comprehensive report on electrification efforts and promotion in the Bay Area and three cities outside California, as well as analyzed the potential use of heat pump water heaters as an electrification policy to help meet Alameda's 2030 Climate Action Reliencey goals. Finally, Andrew Thomas, former Planning, Building and Transportation Director of Alameda, wrote the Electrification Reach Code Staff Report for the Mayor and City Council Members of Alameda making a recommendation to adopt the 2019 edition of the California Green Building Standards Code with certain Exceptions, Deletions, Modifications, Additions, and Amendments.

To fully eliminate fossil fuel emissions from residential buildings, every unit would have to be completely electrified. The CARP plan estimates that it could cost $30,000 for some single

family homes, or $900 million citywide.[1] The plan also notes that it is likely a mandate will be required in order to achieve a majority of retrofits.[2] Alameda's 2019 Climate Action and Resiliency Plan set new Greenhouse Gas reduction goals, specifically by setting the goal of reducing emissions by 50 percent below 2005 levels by the year 2030.[3] For the building sector,

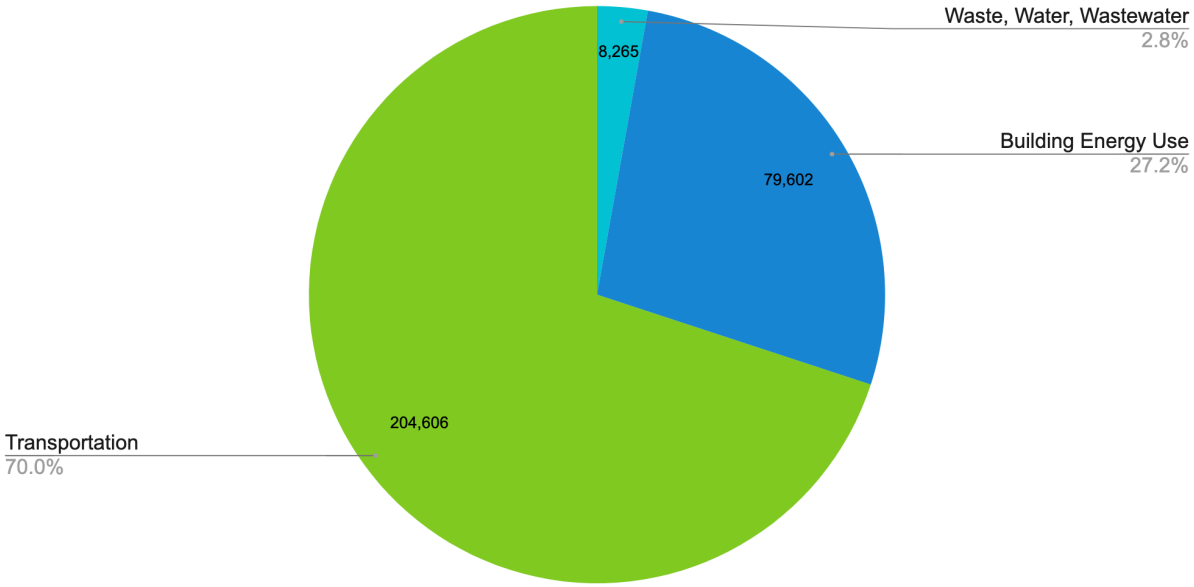

Figure 1. Alameda's 2020 GHG projections, including impacts from already committed to actions. *shows that beginning in 2020 with AMP's delivery of 100 percent clean electricity, the majority of Alameda's emissions will come from the transportation sector (i.e., about 70 percent of Alameda's annual GHG emissions). To reach our sustainability goals, Alameda must achieve deep cuts in transportation emissions.*[4]

[1] *Alameda Climate Action and Resiliency Plan (CARP)*. 2019. Alameda: City of Alameda. Available at: <https://www.alamedaca.gov/files/sharedassets/public/public-works/climate-action-page/new-folder/final-carp-9-2019/alameda_carp_final_091119noappendices.pdf ` > pg41
[2] *Id.*
[3] *Id.*
[4] *Alameda Climate Action and Resiliency Plan (CARP)*. 2019. Alameda: City of Alameda. Available at: <https://www.alamedaca.gov/files/sharedassets/public/public-works/climate-action-page/new-folder/final-carp-9-2019/alameda_carp_final_091119noappendices.pdf ` >

this goal already has a head start because Alameda Municipal Power already delivers 100 percent clean electricity to the City.[5] Additionally, the City of Alameda will likely be passing a new construction building reach code in the summer of 2021, which will require all new construction on the island to be electric. These actions mean the remaining carbon emissions come from the City's existing building stock. Therefore, the bulk of the City of Alameda's efforts to meet its 2030 goals need to target existing buildings, which include single family residential, multifamily residential, commercial, industrial, and government buildings.

In the 2019 CARP plan, the City of Alameda had two specific goals related to existing buildings. The first is a general fuel switching goal, where it is assumed that 12 percent of residential and commercial natural gas is replaced with electricity by 2030, accounting for a reduction of 7,836 MTCO2e.[6] CARP also had a second, more specific electrification goal, focused on programs encouraging residential fuel switching. This goal assumed a greenhouse gas emissions reduction of 447 MTCO2e. To achieve those emissions reductions, CARP assumes that 3,819 of AMP's residential customers (10 percent) will replace natural gas clothes dryers with electric dryers and 1 percent (382 customers) will replace natural gas water heaters with electric heat pump water heaters by 2030.[7]

These have all been important steps towards existing building decarbonization, and this report's goal is to build from and expand upon this work in such a way that guides the final electrification policy adopted by the city.

[5] *Id.*
[6] *Id.*
[7] *Id.*

III. Weatherization and Electrification Methods

a. Energy Efficiency Methods

In order to capitalize on the work that has already been done on the electrification effort in Alameda, we only explored efficiency and electrification methods that had already been proposed and analyzed in the 2019 Frontier Energy Report. This allowed us to make general estimations on the effectiveness of each method on carbon reduction in Alameda as well as understand which methods would be cost-effective for Alameda residents. Below, we briefly outline how each efficiency and reduction method from the Frontier Energy Report works. When we refer to electrification and weatherization projects throughout the rest for the report, we are referring to this list. Each of these efficiency methods is attributable to the Frontier Energy Report.[8] We did not include electric stoves in this list both because Frontier energy did not provide reduction information on them, and because of the specific challenges in getting consumers to switch from gas to electric cooking that we go into further detail later in the report.

<u>Attic Insulation:</u>

This measure entails adding R 49 insulation to vented attic spaces. This also includes updating recessed can lighting to be airtight and to allow for insulation contact, which prevents further heat seepage.

[8] Frontier Energy, Inc., Misti Bruceri and Associates LLC, 2019. *2019 Cost-Effectiveness Study: 2020 Analysis of Low-Rise Residential Addendum – City of Alameda Analysis*. Alameda: Pacific Gas and Electric Company.

Air Sealing and Weather-Stripping:

Air sealing entails finding and sealing all points of air seepage from the inside of the home to the outdoors. In the Frontier analysis we used, different air seepage levels were used for different vintages of homes, and that in general, 30 percent of air seepage could be prevented by a full house air-sealing. So for the oldest bracket of homes, ACH50 could be reduced from 15 to 10, in the middle bracket from 10 to 7, and in the newest homes, ACH50 could be reduced from 7 to 5.

Cool Roof:

This measure was only considered for homes that are re-roofing as part of a remodeling project, so the cost savings analysis is a differential between re-roofing using cool roof materials versus standard materials–not between re-roofing and not re-roofing. A 'cool roof' has an aged solar reflectance of a minimum of 0.25 and thermal emittance of a minimum of 0.75 per the Cool Roof Rating Council (CRRC). This only applies to steep roofs and matches Title 24 in aged solar reflectance requirements but has a higher thermal emittance requirement.

Raised Floor Insulation:

For homes that have raised floors and no current floor insulation, this requires the addition of R 19 insulation to the floors of the home.

Wall Insulation:

For homes that have no current wall insulation (assumed to be the pre-1978 stock), this requires the addition of blow-in R 13 insulation to the walls of the home.

Window Replacement:

This only applies to the oldest and middle vintages of homes. It entails removing metal frame windows and replacing them with a dual-pane window that meets Title 24 requirements of efficiency.

Duct Sealing, New Ducts, and Duct Insulation:

This requires air-sealing all ductwork to meet Title 24 requirements. This means final duct leakage can equal 10 to 15 percent per Title 24 code Section 150.2(b)1E either via sealing existing ducts or replacing them with all new ductwork.

Water Heater Blanket:

A water heater blanket is an addition of R-9 insulation to the outside of a residential tank storage water heater to prevent water heat loss. It was modeled based on an older home layout, which typically places the water heater in a conditioned space.

Hot Water Pipe Insulation:

Similar to the water heater blanket, this prevents water heat loss during transport from the heater to the faucet. It entails adding R 3 insulation to all accessible pipes. However, because most pipes are underground, only about 10 percent of water pipes can be insulated this way.

Low Flow Fixtures:

Faucets in the house must be upgraded to meet Title 24 Part 11 (CALGreen) requirements–a maximum flow rate of 1.8 gallons per minute (GPM) for showerheads and kitchen faucets, and 1.2 GPM for bathroom faucets. This is typically a flow reduction of 10 percent in showers and 20 percent on faucets.

LED Lighting:

The Frontier Analysis modeled how switching traditional lightbulbs as well as Compact Fluorescent Lamps (CFL) with screw-in light-emitting diode (LED) lights increased home

efficiency. The estimation of lifetime use and energy savings were based on a 2010 lighting study by KEMA: "I Know What You Lit Last Summer."[9]

Exterior Lighting Controls:

According to an analysis done by the Consortium for Energy Efficiency, installing a screw-in photosensor to outdoor lighting fixtures reduces operation time by 20 percent each day.[10]

Ducted Heat Pump:

This entails replacing an existing ducted gas furnace and air conditioner (AC) with an electric heat pump–both minimum federal requirements of efficiency and more efficient versions were explored. Savings were compared to replacing it with a new gas furnace.

Heat Pump Water Heater (HPWH):

There has been much talk about the benefits of replacing gas storage tank water heaters with an electric heat pump water heater. This analysis examined both minimum federal requirement efficiency heaters as well as a more efficient heat pump heater (Northwest Energy Efficiency Alliance Tier 3 rating). The final analysis was based on a new 80 gallon unit with a UEF of 3.45 compared to a new 50-gallon gas storage heater with a UEF of .63.

Photovoltaics:

Photovoltaics, or PV, are solar panels placed on a home. They are required for new home construction, but not on existing buildings. This analysis only looked at two prefabricated sizes of PV, as opposed to PV custom systems that maximize each houses' energy efficiency.

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[9] Gaffney, K., Goldberg, M., Tanimoto, P. and Johnson, A., 2021. *I Know What You Lit Last Summer: Results from California's Residential Lighting Metering Study*. [online] Aceee.org. Available at: <https://www.aceee.org/files/proceedings/2010/data/papers/2225.pdf>.

[10] Eaton, E., 2014. *Residential Lighting Controls Market Characterization*. [ebook] Boston: Consortium for Energy Efficiency. Available at: <http://ttps://library.cee1.org/system/files/library/11458/CEE_LightingMarketCharacterization.pdf>.

Energy Storage (Batteries):

Energy storage batteries to go with a PV system were analyzed in the same way as the PV system-not as a custom maximizing battery system, but based on a few prefabricated battery systems.

High Efficiency Air Conditioning:

For buildings with air conditioning, this entails replacing existing AC with a single-speed 16 SEER/13 EER unit.

IV. Financing Mechanisms

When considering financing mechanisms for electrification and weatherization projects, there are two main buckets: the extant rebate structures employed by various utility providers (including the current system Alameda Municipal Power uses), and non-rebate alternative financing strategies which include the split utility user tax, on-bill financing, Property Assessed Clean Energy Programs, and fee structures. This report will describe and analyze the current rebate programs used by three relevant utility companies for key takeaways and will describe and analyze alternative financing options for their pros, cons, and equity potential.

a. Rebate Structures

i. Alameda Municipal Power (AMP) Rebates

Currently, when Alameda residents decide to make certain efficiency or electrification upgrades to their homes, they have the option to apply for rebates on those expenses. These

rebates are intended to encourage energy-efficient choices when upgrading equipment in the home. The full rebate offerings are summarized below:

Table 1. Summary of Alameda Municipal Power's electrification and efficiency rebates currently offered.[11]

Upgrade	Rebate Amount
Electric Clothes Dryer	$100
Electric Washing Machine	$150
Heat Pump Water Heater	$1,500
LED Fixtures with Integrated LED Light Bulb	$8 or $15 per fixture
Residential Panel Upgrade	up to $2,500

Analysis

With these rebates, a full retrofit could qualify for more than $4,250 in money back, which is a significant amount of savings on a retrofitting project. AMP currently communicates these rebates with customers via bill inserts for paper bill customers and via emails to digitally paying customers. Other customer education strategies include an electrification webinar series that is planned to include demonstrations of electric cooktops and other appliances, information in their monthly newsletter The Flash, and in the future, a dedicated website to electrification benefits and available rebates. AMP reported that the most successful (meaning: utilized) home electrification rebate is the heat pump water heater rebate, followed by the clothes dryer and washer rebates. AMP representatives noted that after raising the rebate

[11] Alamedamp.com. 2021. Rebates & Incentives | Alameda Municipal Power, CA. [online] Available at: <https://www.alamedamp.com/164/Rebates-Incentives>.

amount on heat pump water heaters from $500 to $1500, the utilization rates jumped as well (from 4 to 20) in one year.[12]

It is worth noting that the majority of AMP's outreach is focused on the rebate for electric vehicle chargers, consequently, this is the most utilized rebate by customers. While this is an important move in the overall fight against carbon emissions, it is outside the range of focus on electrified and decarbonized existing buildings.

Takeaways

Rebates on electrification are an important financing mechanism in Alameda, and show a general willingness of residents to decarbonize when the price is made more affordable. The increase in usage of the heat pump water rebate when the amount was increased shows that, unsurprisingly, the amount of rebate offered on a project directly impacts how many people will find the upgrade feasible. Furthermore, the success of the EV charging rebate program shows that dedicated outreach also works to increase program participation.

While these rebates are important, they do not cover many weatherization strategies or electrification strategies that are explored by the Frontier Report and may be important elements to an effective electrification strategy.

b. Alternative Financing Mechanisms

i. Split Utility User Tax

Utility user taxes (UUT) are imposed by some cities and counties on the use of goods like telephone usage, electricity, water, gas, and solid waste management. In terms of electrification, they can be used to lightly penalize the use of gas, and incentivize the use of electricity by raising the UUT on gas and lowering the UUT on electricity–hence the 'split' UUT. Cities like Vallejo, which does not employ a split UUT, often charge the same UUT rate on both

[12] Goldman Team and Alameda Municipal Power meeting, March 31, 2021 11:30am PST

gas and electricity.[13] Currently, Alameda does not employ a split UUT and charges 7.5 percent tax on both gas and electricity.[14] For example, by raising the rate on gas to 8.5 percent and lowering the rate on electricity to 6.5 percent, Alameda can encourage the switch without changing overall city revenue by a significant amount.

Pros

Practically, this could be a simple way to change the tax structure to support decarbonization. Another benefit is that lower income users of utilities can be exempt from these tax changes, which would prevent generating utility cost stranding, where more affluent neighborhoods are able to shift away from a utility, which ends up piling costs on lower income areas.

Cons

Politically, changing tax structure can be challenging, and those who feel that they must keep up some usage of gas (people with a very high attachment to their gas stove, for example) will feel unfairly penalized. Gas providers will also lobby against this solution, which is a political barrier that must be assessed before attempting to pursue this strategy.

ii. On-Bill Financing

On-bill financing of retrofits is a maneuver where customers obtain loans from their utility provider in order to pay for the upfront cost of electrification and weatherization projects. Customers are then able to pay back the loan via the savings as result of that project, often over years or even decades. After the loan is paid back, savings from the project go directly to the customer. This is the financing strategy that was used in the cost benefit analysis in the

[13] Cityofvallejo.net. 2021. *Utility Users Tax (UUT) Information*. [online] Available at: <https://www.cityofvallejo.net/city_hall/departments___divisions/finance/utility_users_tax___u_u_t__information>

[14] Uutinfo.org. 2021. *City of Alameda - UUT*. [online] Available at: <http://www.uutinfo.org/uutinfo_city_info/alameda/uutinfo_alameda.htm>.

Frontier Energy report. PG&E offers commercial customers on-bill financing loans of $5,000-$100,000 that can be paid back over up to 60 months.[15]

Pros

This method helps avoid large up front costs to customers who are looking to electrify, making these strategies more available to middle and lower income customers. There is also precedent in PG&E's on-bill financing program. AMP has expressed interest in replicating PG&E's program for their customers.

Cons

Despite expressing interest in this mechanism, AMP acknowledges that there are programmatic barriers to actually pursuing this strategy. This also requires the utility to be able to pay those up front costs for the electrification and weatherization projects, which may not be possible for smaller community-based utilities like AMP.

iii. Inclusive Financing

Inclusive Financing or 'tariffed on-bill financing' is another potential financing solution. It is similar to on-bill financing, in that both programs are paid through a customer's utility bills. However, as noted above, on-bill financing is a loan program that customers must take out and get approved by the utility or a third-party financier, which they then repay through their utility bill. By contrast, tariffed on-bill financing is structured so that any electrification or efficiency improvements made are considered an investment that the utility can recover through tariffs on customer's bills. This tariff charge is tied to the physical location of the utility bill and upgrade made. Almost all tariffed on-bill financing programs currently operating use a program

[15] Pge.com. 2021. *The ABCs of OBF: Learning How PG&E's On-Bill Financing Works | PG&E*. [online] Available at: <https://www.pge.com/en/mybusiness/save/smbblog/article/the_abcs_of_obf_learning_how_pges_onbill_financing_works.page?redirect=yes>.

called Pay As You Save® (PAYS®), which was developed by Energy Efficiency Institute, Inc. and is licensed to utilities for implementation.[16]

Pros

There are a variety of benefits to inclusive financing. The biggest benefit is that customers begin to see savings immediately. The program is typically designed so that customers do not have to pay more than 80 percent of the estimated yearly savings. Another benefit is that the tariff is tied to the meter of the building with the upgrade which allows this program to be available to both renters and homeowners. Additionally, because inclusive financing is considered a recoverable investment for the utility, there are no upfront costs for customers, which can be a big equity concern when considering the eligibility of low-income residents. Plus, bill payment history through the utility can be considered instead of credit scores and there is evidence that utilities who participate do not have people defaulting on their bill payment.[17]

Cons

Likely the biggest downside to this financing model is Alameda's climate. Further research should be done, but based on initial work done by Frontier Energy there will potentially be quite a few electrification and efficiency upgrades that may require an upfront payment in order to meet the 80 percent of annual cost payment requirements. Two other potential issues are the potential administrative costs for AMP to implement this program as well as the potential timeline. Since there are no similar programs in California, implementation will take some time, which will affect Alameda's 2030 goals. Finally, this program will require some kind of upfront capital investment from AMP or a third party financier.[18] One potential solution could

[16] *Tariffed On-Bill Financing Feasibility.* 2019. CADMUS. Available at: <http://energytransition.umn.edu/wp-content/uploads/2019/08/Minnesota-TOB-Financing-FINAL_AH-1.pdf>.
[17] CommunityPowerMN.org . 2021. *Inclusive Financing FAQ*. [online] Available at: <https://www.communitypowermn.org/inclusive_financing_faq>.
[18] *Decision Tool for Utility Managers.* 2016. The Energy Efficiency Institute, Inc.: Vermont. Available at: <https://www.roanokeelectric.com/wp-content/uploads/Decision-Tool-for-Utility-Managers-v14.pdf>.

be using Alameda's 2022 bonding initiative, especially because getting a low interest rate could be crucial to mitigating some of the climate cost-effectiveness issues. One other potential hurdle is that any changes renters want to make have to be approved by building owners, so this financing mechanism does not provide a solution to those dynamics, which will likely require outreach and coordination on both fronts.

iv. Property Assessed Clean Energy (PACE) Programs

PACE programs are government-run financing mechanisms for both commercial and residential properties that wish to make renewable energy improvements.[19] PACE programs are similar to On-Bill financing in that they allow the property owner to take a loan for the project and pay it back over time via voluntary assessment. An interesting element of PACE programs is that the loan is tied to the property, not the person, so the payments do not travel with the sale of the property. California currently has ten residential PACE programs available to homeowners.

Pros

Similar to on-bill financing, customers avoid large upfront costs for projects, and are assured a long repayment period. There are also low interest rates associated with PACE due to the security associated with land-based (not person-based) loans. Both of these factors make this a fairly equitable strategy among varying income groups of homeowners.

Cons

These programs are only available to homeowners, which poses equity issues. Furthermore, it does not apply to portable improvements to the property, like refrigerators or lightbulbs, and is not suitable for smaller projects that cost under $2,500 total.[20] Additionally, based on conversations with people in the community, the rollout of PACE in the City of Alameda did not

[19] Energy.gov. 2021. *Property Assessed Clean Energy Programs*. [online] Available at: <https://www.energy.gov/eere/slsc/property-assessed-clean-energy-programs>.
[20] *Id.*

go smoothly and it has not seen a lot of success, so public outreach and reeducation may be necessary or simply using another financing mechanism.

v. Permit Fees

Permit fees are paid to the city whenever there is new construction on an existing building or from scratch. There are five different permit types: building, plumbing, mechanical, electrical, or combo. According to the City of Alameda website, a permit is required whenever an owner of a building "intends to construct, enlarge, alter, repair, move, demolish, or change the occupancy of a building; or to erect, install, enlarge, alter, repair, remove, convert or replace any electrical, gas, mechanical or plumbing system."[21] The current building fee structure is summarized below.

Similarly to the split utility user tax, permit fees could be reconstructed to be lower for construction on electrical systems and raised on construction done on gas systems. In this way, the city could encourage a shift towards electrification via a permit application contact point.

[21] Alamedaca.gov. 2021. *When is a permit needed?*. [online] Available at: <https://www.alamedaca.gov/Departments/Planning-Building-and-Transportation/Permit-Center/When-Is-A-Permit-Needed> .

Table 2. Summary of the City of Alameda's Permit Fee Schedule.[22]

Scope of Work	Permit Type	Fee
Bathroom Remodel / Less Than 300 Sq Ft / *No Structural or Exterior Changes*	Combo	$1,411.08
Earthquake Gas Shut-Off Valve	Plumbing	$157.20
Furnace Install or Replacement	Mechanical	$400.30
Kitchen Electrical Upgrade	Electrical	$414.30
Kitchen Remodel / Less Than 300 Sq Ft/ No Structural or Exterior Changes	Combo	$1,684.42
Re-Roof / No New Sheathing	Building	$257.27
Re-Roof w/ New Sheathing	Building	$396.56
Residential Remodel / Less Than 300 Sq Ft No Exterior Changes	Combo	$1,532.12
Stair Repair or Replacement	Building	n/a
Solar Panel(s)	Electrical	$500.00
Termite / Dry Rot Repair	Building	$727.69
Water Heater Install or Replacement	Plumbing	$284.30
Window/Door Replacements • 1-5 Windows/Doors • 6-10 Windows/Doors • 11-15 Windows/Doors • 16-20 Windows/Doors	Building	 • $604.61 • $860.46 • $1,116.30 • $1,373.15

[22] Alamedaca.gov. 2021. *City of Alameda Master Fee Schedule*. [online] Available at: <https://www.alamedaca.gov/files/assets/public/2018-19-master-fee-schedule.pdf>.

Pros

One of the major advantages of this strategy is that it would effectively educate and involve the contractor community about the city's priority on electricity. City and AMP representatives have repeatedly mentioned that contractors are important stakeholders in any retrofit-focused effort. However, they have been challenging to engage with on this front. Because they deal every day with the permitting process, this system would inherently effect, and therefore connect them to this effort. Another benefit to this mechanism is that it requires little to no administrative time or effort once passed.

Cons

This strategy does have some potential equity issues in that it may penalize lower-income households who need to fix their existing gas infrastructure, but cannot afford to fully switch over to electricity. One potential solution is to provide vouchers for the fee increases, but that may mean losing the benefit of the low administrative lift this strategy requires. Some of the current exemptions to the fee structure would also mean that many important contact points are missed. At the moment installing portable heating, cooking or clothes drying appliances does not require a permit (residential construction). This means that a split fee policy would miss anyone who is installing a stove, clothes washer, and clothes dryer. These are some of the most important electrification points, so the permit fee mechanism could not alone impact building decarbonization.

V. Points of Intervention

One of the great challenges of decarbonizing existing buildings is finding effective and equitable points of policy intervention. Because of the complexity of electrification and weatherization projects and the diversity of buildings and consumers that policies need to

reach, it will most likely require a combination of different intervention points in order to bring all of Alameda completely onto the electricity grid. Each point of intervention would also need to be paired with an appropriate financing mechanism.

a. Point of Sale

One of the most effective policy intervention points for existing buildings is the point of sale. While the speed at which this policy could impact all single family homes is dependent on the current housing market health, engaging homeowners when they are in the process of selling or buying a home systematically reaches hundreds of buildings per year. To utilize this intervention point, the City of Alameda could require that certain efficiency or electrification measures be completed either at the time of listing or during a certain period after the sale. In this way, houses will become more decarbonized with each sale.

There are two downsides to this strategy. First, while point of sale measures will get to most houses, there is a subset of homes that remain under single ownership for decades at a time. Additionally, if the realtor community is not on board with the policy it can become politically untenable very quickly. There is often resistance to any measure that may further complicate the selling process. However, based on work done by a previous intern for CASA, real estate agents in Sacramento are on board with the city's point of sale policy, so consulting all of the stakeholders for this policy can help make this more feasible.[23]

b. Point of Permit

Another potential point of intervention is during home remodeling. This policy would require that when the city issues a permit for renovation, it would also require certain efficiency or electrification measures. This is a natural intervention point from an administrative standpoint, because the City of Alameda already has a permitting process in place for renovations. This point of intervention also has the potential to be harmonious if the efficiency/electrification requirements are coordinated with the renovation that is happening. For example, if there is

[23] Previous interview conducted by CASA intern.

wiring being done in the attic, the city could require attic insulation installation at that time. There are also potential downsides, depending on what level the efficiency/electrification requirement is triggered it could create an additional cost burden for homeowners that they were not anticipating. Also, as was noted in work done by a previous intern, the City of Alameda is already seen as a costly and complicated place for remodeling projects by the construction industry. There is a chance that the addition of further permitting requirements could discourage homeowners from remodeling at all.

c. Burnout

One of the most natural intervention points for electrification of appliances is to require the purchase of an efficient and electric appliance to replace old units that have broken down. This policy applies not only to the obvious appliances like stoves, clothes washers, clothes dryers, air conditioning units, and water heaters, but can even apply to non-traditional things like lightbulbs, window replacement, or even re-roofing. In this way, cities can encourage a natural progression towards electrification in addition to more aggressive policies. The challenge of this point of intervention is that typically new appliances like refrigerators, hot water heaters, and the like are purchased in a state of low emergency. People typically will not go very long without one of these appliances, so reaching that consumer within the small time window between appliance burnout and replacement can be difficult. Because of this, the burnout point of intervention requires consumer education before the point of burnout, and ideally, generous rebates.

d. Solar, Air Conditioning, or Electric Vehicle Charger Installation

Consumers who are already pursuing large projects like air conditioning installation or electrical projects like installation of photovoltaics or an electric vehicle charger are a target for other electrification and weatherization requirements. Requiring upgrades or fuel switches in the rest of the home at the point of these projects could help pick off some of the ‘low hanging fruit’ homes that are ready for a fuel switch. There would have to be further study into what

level of requirement would be effective, but also would not deter homeowners from pursuing these projects in the first place. This intervention point would be best paired with rebates and split fees in order to make the mandates' extra work more affordable and to avoid disincentivizing solar or EV work.

VI. Decarbonization Case Studies

a. City Case Studies

Part of our research involved looking at other cities in California and the Bay Area to see what they were trying and try to determine if any of those policies could be transferred to Alameda. The cities we included were Piedmont, Berkeley, and Santa Monica. Piedmont just passed an existing building reach code this winter, Berkeley is in the early stages of developing an existing building reach code, and Santa Monica's reach code went into effect at the beginning of last year. We felt that there were pieces of each city's policies and plans that could be beneficial to the City of Alameda which the case studies below attempt to highlight. Additionally, we created a case study of the Sacramento Municipal Utility District (SMUD), which is doing excellent work on electrification and efficiency retrofits, and we see it as a potential model or collaborator for AMP. Finally, we included a breakdown of BayREN and the programs and rebates they provide because we believe they are being underutilized in Alameda.

i. City of Piedmont

The city of Piedmont passed existing building reach codes on February 1, 2021.[24] The benefits of studying Piedmont as a case study in decarbonization is the similar climate and

[24] Piedmont.ca.gov. 2021. *Reach Codes*. [online] Available at: <https://piedmont.ca.gov/government/city_news___notifications/reach_codes>.

weatherization requirements that Alameda and Piedmont homes face. The drawbacks include the vast difference in the housing stocks between the two cities, as well as the difference in financial and community resources available to the City of Piedmont that are not available to the City of Alameda. Despite these differences, there are still important lessons that can be learned from the City of Piedmont's process and final reach code.

The reach codes' most interesting element is the requirement of a Home Energy Audit or a Home Energy Score at the point of sale of the home. There are a few exemptions for homes where an audit or score has already been completed in the past five years, and for all homes that are built within the past ten years. There is a slight difference between Home Energy Audits or Home Energy Scores. Home Energy Scores are based on requirements from the Department of Energy and fall on a scale from 1-10. Home Energy Audits are more in-depth and more expensive, but provide more detailed information about the building.

The City of Piedmont also has robust requirements for homeowners throughout the permitting process for remodels and projects. Here are the requirements from the City's website:

- Projects that include an entirely new level or expand the total roof area by 30 percent or more, must install solar panels on the roof.
- A renovation project that costs $25,000 or more must include an energy-efficient insulation or heating system electrification improvement to include in the renovation.[25]
- A renovation project that costs $100,000 or more must include two energy efficient insulation or heating system electrification improvements to include in the renovation.
    - The energy efficient insulation or heating system requirement can be modified with a Home Energy Score of at least a 7 completed in the last five years.[26] This

[25] Piedmont.ca.gov. 2021. *City Council of Piedmont, Agenda, February 1, 2021*. [online] Available at: <https://piedmont.ca.gov/common/pages/DisplayFile.aspx?itemId=17376920>.
[26] *Id.*

modification is included so homes that have been pursuing energy efficiency measures can be recognized for their efforts.

- An application for an electrical panel upgrade must include capacity in the panel to accommodate future electrification of all appliances in the residence.
- An application for a kitchen or laundry area renovation must include electrical outlets for future appliance installations.
- If the renovation is less than $25,000 and involves replacing the electrical panel, the Ordinance would require the electrical panel to include space for future electrification (upfront cost $400). If the renovation included a kitchen or laundry area remodel, the Ordinance would require electrical outlets to be installed in the kitchen/laundry area (upfront cost $200).[27]

The City of Piedmont also conducted public outreach surveys while drafting their Reach Code, and found that the top concerns about electrification among residents was vulnerability during power outages, unfair to existing improvement work homeowners may have already done, cost, new code may be too confusing, bureaucratic overreach, and too restrictive.[28]

Additionally, the City of Piedmont included a list of projects not affected by their ordinance, which seems to miss a lot of potential synergistic work. For example, furnace replacements, many window replacements, most roof replacements, and electrical rewiring are all exempt projects under the new reach code, but are all potential projects where significant efficiency improvements could be achieved.[29]

ii. City of Berkeley

Existing Work

The City of Berkeley passed its reach code in 2019 along with the country's first natural gas hookup ban in new buildings. The reach code focused on pathways for both all electric and

[27] Piedmont.ca.gov. 2021. *City Council of Piedmont, Agenda, February 1, 2021*. [online] Available at: <https://piedmont.ca.gov/common/pages/DisplayFile.aspx?itemId=17376920> . Page 41.
[28] *Id.* Pages 7,8,9.
[29] *Id.* Page 10.

mixed fuel new construction that exceeded the state's Title 24 requirements. It also expanded solar requirements for residential homes and requires electrification readiness in buildings that still use natural gas. The point of intervention for these guidelines is during the permit application, issuance, and inspection processes.

Table 3. Explanation by the City of Berkeley of the differences between an electrification reach code and natural gas prohibition ordinance.[30]

	Natural Gas Prohibition Ordinance	Reach Code for Electrification
Requirements	Prohibits natural gas infrastructure in new buildings.	Provides two compliance pathways: All-electric or more efficient mixed-fuel.
Covered Buildings	Applies to newly constructed buildings* that submit a Use Permit or Zoning Certificate after January 1, 2020.	Applies to newly constructed buildings* that submit a Building Permit application after January 1, 2020.
Exceptions and Qualifications	Determined on a case-by-case basis when all-electric not feasible or project determined to be in public interest. Requirements for future electrification when natural gas is used.	Efficiency requirements beyond the Energy Code for mixed-fuel vary by building type based on cost-effectiveness. All-electric buildings are cost-effective. Requirements for future electrification when natural gas is used.
Status	Adopted by City Council on July 23, 2019 as Ordinance No. 7,672-N.S. to add a new Chapter 12.80 to the Berkeley Municipal Code	Adopted by City Council on December 3, 2019 as Ordinance No. 7,678-N.S. to reenact Chapter 19.36 of the Berkeley Municipal Code

* Newly constructed building refers to a building that has never been used or occupied for another purpose, and excludes remodels and converted buildings. This applies to both residential and nonresidential buildings.

Below is a summary released by the City of Berkeley explaining why both the reach code and the gas ban were important and different from each other in terms of carbon goals.
While it does not relate to carbon emissions, Berkeley's transfer tax rebate for homeowners who do a seismic retrofit for homes within the first year of purchase provides a blueprint for an

[30] Cityofberkeley.info. 2021. *City of Berkeley Natural Gas Prohibition & Reach Code for Electrification*. [online] Available at: <https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Berkeley%20Energy%20Reach%20Code%20for%20Electrification%20and%20Natural%20Gas%20Prohibition%209-27-19.pdf> .

electrification mechanism. The 'Seismic Retrofit Refund Program' allows for up to 33 percent of the city's 1.5 percent property transfer tax to be refunded if the new owner of the property completes voluntary seismic upgrades within the first year of property ownership.[31] This is a creative way to encourage homeowners to make socially beneficial decisions that could be emulated for electrification and weatherization projects in Alameda.

Existing Building Decarbonization Plan

At the end of April 2021, the City of Berkeley in collaboration with RMI[32] released a draft plan for an existing building decarbonization plan. The plan includes many similarities to this report. RMI conducted a housing analysis using tax assessor's parcel data. Additionally, their recommendations revolved around four points of intervention: Time of Replacement and Renovation, Time of Sale, Building Performance Standards, and Neighborhood Electrification and Natural Gas Pruning. Those points of intervention were tied to the "three pillars" of education, accessible funding & financing, and regulatory changes. This structure is supported by "equity guardrails" as defined by the Greenlining Institute's Equitable Building Electrification Framework. Many of the recommendations are similar to the ones made at the end of this report. Reaching out to the City of Berkeley and attempting to form a partnership or information sharing network we believe would be incredibly useful as both cities are at very similar stages in the existing building decarbonization process.[33]

iii. City of Santa Monica

In pursuit of their goal of 80 percent carbon reduction by 2030 and full carbon neutrality by 2050, the city of Santa Monica installed a successful reach code that went into effect on

[31] Cityofberkeley.info. 2021. *Real Property: Transfer Tax Seismic Refunds - City of Berkeley, CA*. [online] Available at: <https://www.cityofberkeley.info/Finance/Home/Real_Property__Transfer_Tax_Seismic_Refunds.aspx>.
[32] Formerly Rocky Mountain Institute
[33] Cityofberkeley.info. 2021. [online] Available at: <https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Draft_Berkeley_Existing_Bldg_Electrification_Strategy_20210415.pdf>.

January 1st, 2020.[34] In addition to its reach code, Santa Monica was one of the first cities to pass solar photovoltaic requirements in newly constructed buildings, and is planning to mandate electrification by early 2022.[35] The City of Santa Monica is widely considered a leader in green code, and won the 2020 National Leadership in Sustainability Award for its aggressive reach code requirements.

Similarly to Berkeley's reach code, Santa Monica has provided two pathways for new buildings to meet the reach code: all electric or mixed fuel with high efficiency. These two pathways are further divided by building category: category one includes residential buildings three stories or less, single family homes, multifamily buildings, and accessory dwelling units (ADUs), and category two includes high-rise residential buildings, as well as some non-residential buildings like hotels and motels.

Furthermore, all new buildings must have a Certified Energy Analyst (CEA) review and sign a Title 24 Certificate of Compliance.

There are other requirements for homes undergoing major additions, which is defined as the addition of a new story or increasing the floor footprint by 50 percent. When making such an addition, single and double family homes must add photovoltaics "with a minimum total wattage of 1.5 times the square footage of the addition's footprint" and larger residential units and commercial units must add photovoltaics "with a minimum total wattage of two times the square footage of the addition's footprint."[36]

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[34] Santamonica.gov. 2021. *City of Santa Monica | Official Website*. [online] Available at: <https://www.santamonica.gov/blog/santa-monica-receives-the-2020-national-leadership-in-sustainability-award-from-the-international-code-council>.
[35] Santamonica.gov. 2021. *City of Santa Monica | Official Website*. [online] Available at: <https://www.santamonica.gov/blog/santa-monica-receives-the-2020-national-leadership-in-sustainability-award-from-the-international-code-council>.
[36] Smgov.net. 2021. *Energy Reach Code - Community Development Department - City of Santa Monica*. [online] Available at: <https://www.smgov.net/Departments/PCD/Permits/Codes-Standards-Requirements/Energy-Reach-Code/>

Table 4. Summary of the City of Santa Monica's requirements for each pathway to meet the new building reach code.[37]

	Category One	Category Two
All Electric	• All-electric end uses • No natural gas or propane appliances • No gas meters or propane infrastructure • Compliance with the energy efficiency standards required by the State (no additional local energy efficiency requirements)	• All-electric end uses • No natural gas or propane appliances • No gas meters or propane infrastructure • Compliance with the energy efficiency standards required by the State (no additional local energy efficiency requirements)
Mixed Fuel	• Natural gas and electric allowed for all appliances • Meeting standards for mixed-fuel designs as specified for CalGreen Tier 1 under the 2019 California Green Building Standards Code, Title 24, Part 11, Appendix A4 Residential Voluntary Measures Division A4.203-Performance Approach for Newly Constructed Buildings. Project must achieve a Total EDR of 10 or less	• Natural gas and electric allowed for all appliances • High-rise residential and hotel/motel buildings must have a 5% compliance margin as demonstrated on the Title 24 Certificate of Compliance • Non-residential buildings must have a 10% compliance margin as demonstrated on the Title 24 Certificate of Compliance

[37] Smgov.net. 2021. *Energy Reach Code - Community Development Department - City of Santa Monica*. [online] Available at: <https://www.smgov.net/Departments/PCD/Permits/Codes-Standards-Requirements/Energy-Reach-Code/>.

b. Rebate Case Studies

i. Bay Area Regional Network (BayREN):

One source of rebates already available to Alameda residents is BayREN, a bay area energy network that is funded by a combination of California utility ratepayers, and member agencies.[38]

Table 5. Summary of BayREN's electrification and efficiency rebates currently available.[39]

Upgrade	Rebate Amount
Air Sealing	$150
Heat Pump Dryer	$300
Heat Pump Water Heater	$400-$1000
Duct Replacement or Sealing	$200-$800
Heating and Cooling Equipment	$300-$1000
Induction Cooktop	$300
Insulation	$0.70/sq. ft. – $0.75/sq. ft. Up to $1,000
Energy Savings Kit (Faucets, LEDs, Power Strips)	$70
Home Energy Score	$200

Beyond rebates, BayREN also offers a variety of resources and information. BayREN offers consumers an online evaluation, ability to speak to a BayREN Home Energy Advisor, and information to help find a contractor.[40]

[38] BayREN.org. 2021. *About BayREN*. [online] Available at: <https://www.bayren.org/about-bayren>.
[39] BayREN.org. 2021. *BayREN Electrification*. [online] Available at: <https://www.bayren.org/electrification>.
[40] BayREN.org. 2021. *BayREN Homeowners*. [online] Available at: <https://www.bayren.org/homeowners>.

For multifamily housing, BayREN has programs for both renters and building owners. Building owners can qualify for $750 per unit in rebates as well as no-cost energy consulting. BayREN also assists in energy saving retrofits and planning with the goal of saving 15 percent or more of a building's energy and water usage. Priority is given to places that have, “less than 100 units, deed-restricted or naturally-occurring affordable property, resident ownership structure such as an HOA or co-op, or located within a disadvantaged community (determined by the AB 1550 Low-Income Communities map).”[41] Property owners also have the potential to receive additional incentives through the Clean Heating Pathway for fuel switching to highly efficient electric alternatives. Financing for building owners is available and qualifying buildings can receive loans at zero percent interest for up to 50 percent of the project.[42]

Renters have access to three programs through BayREN: OhmConnect, Energy Savings Toolkit, and Green House Call.[43] OhmConnect is a demand management program where renters can sign up to receive email or texts with projected energy savings for the week and if the resident meets or exceeds the goal, they earn points which can be cashed out directly.[44] Renters can also request an energy savings tool kit which is worth $70 or during the summer they can request a Green House Call. BayREN has partnered with Rising Sun Energy Center. Rising Sun Energy is a local initiative that trains youth as Energy Specialists. These Energy Specialists perform home inspections to determine if there are resource conservation opportunities as well as install any equipment necessary to help save energy, water, and money. The youth also provide individualized recommendations for further savings.[45]

[41] BayREN.org. 2021. *BayREN Multifamily*. [online] Available at: <https://www.bayren.org/multifamily>.
[42] *Id.*
[43] BayREN.org. 2021. *BayREN Renters*. [online] Available at: <https://www.bayren.org/renters>.
[44] OhmConnect.com 2021 OhmConnect. [online] Available at <https://www.ohmconnect.com/>.
[45] Rising Sun Center for Opportunity. 2021. *Green House Call - Rising Sun Center for Opportunity*. [online] Available at: <https://risingsunopp.org/programs/ghc/>.

Analysis

BayREN is a great resource to the City of Alameda. Almost all residents of Alameda can benefit from their programs, including homeowners, renters, and multifamily building owners. Residents can qualify for rebates that include both efficiency and electrification upgrades and have access to free consulting. However, they are only available to residents who will continue to hold a PG&E account. Therefore, one of the things to consider is potentially requiring efficiency upgrades before completely electrifying in order to fully utilize BayREN cash rebates. In any scenario, the City of Alameda should look to fully utilize BayREN's entire suite of rebates and resources.

ii. Sacramento Municipal Utility District (SMUD):

The Sacramento Municipal Utility District has one of the best efficiency and electrification programs in the state, which makes it a good comparison to AMP for understanding where AMP can grow in various rebates, financing, and resources available for its customers. The table below summarizes the various cash rebates SMUD currently offers.

Table 6. Summary of SMUD's electrification and efficiency rebates currently available.[46]

Upgrade	Rebate Amount
Induction Stove	$100-$700
Heat Pump Water Heater	$500-$2500
Heat Pump HVAC	$700-$3000
Home Performance Program	Up to $5000
Energy Saving Kit (Faucets, LEDs, Power Strips)	$19 after instant rebate
Water Conservation Kit	$5 after instant rebate

[46] Smud.org. 2021. *SMUD Rebates and Savings Tips*. [online] Available at: <https://www.smud.org/en/Rebates-and-Savings-Tips/Rebates-for-My-Home>.

In addition to a series of rebates, SMUD has an "energy store" which is essentially an online shopping site for everything someone might need to improve efficiency or electrify their home. Items include smart thermostats, smart home devices, lighting, water fixtures, power strips, and air quality products.[47] The website also includes a variety of helpful tips on how to save power, a model home where a resident can click through different parts of the house and see recommendations on how to conserve energy. They even provide lists of SMUD-approved contractors who have been educated in electrification and efficiency projects. There is also a page that walks through all the considerations that should be made for an energy efficient remodel.[48] SMUD also has a residential education page that includes online activities, videos, classes, and presentations on home energy, renewables, electricity and more.[49]

Finally, one of the most important offerings SMUD has is a financing program for energy upgrade projects. The maximum loan amount is $30,000 and they offer 6.99% APR financing (though interest rates may vary). The payback period is 15 years and there is a one-time loan fee of $100. The loan also does not have a prepayment fee, closing cost, origination fee, equity requirement, annual fee, or recording fee, making it fairly equitable for those who might be deterred by extra fees. When SMUD compared their financing with PACE, it outperformed them in every category, except maximum loan amount and payback period.[50]

Analysis

AMP offers many of the same rebates that SMUD has available to its customers. However, SMUD's rebates are often larger and include rebates for different efficiency measures that are also important and should not be overlooked. SMUD also offers some financing options that

[47] Smud.org. 2021. *SMUD Energy Store*. [online] Available at: <https://smudenergystore.com/>.
[48] Smud.org. 2021. *SMUD Rebates and Savings Tips*. [online] Available at: <https://www.smud.org/en/Rebates-and-Savings-Tips/Rebates-for-My-Home>.
[49] Smud.org. 2021. *In Our Community: Workshops*. [online] Available at: <https://www.smud.org/en/In-Our-Community/Workshops-and-education-resources/Residential >.
[50] Smud.org. 2021. *SMUD Rebates and Savings Tips*. [online] Available at: <https://www.smud.org/en/Rebates-and-Savings-Tips/Rebates-for-My-Home>.

AMP does not. The SMUD financing seems to be targeted at projects that are too small for other financing options, but might help convince a homeowner to electrify without having to worry as much about some of the upfront costs. Another successful aspect of SMUD's operations is its website and resources. The website is very accessible and easy to navigate. It includes the information in a variety of ways, from one-page informational flyers to virtual walkthroughs of houses where users can click on different parts of the house and get efficiency and electrification tips. Throughout the website, through a variety of links, SMUD makes it very easy to find a list of their approved contractors as well as financing options.

VII. Methods

a. **Housing Analysis:**

Tax assessor's data contains a variety of information on buildings in the City of Alameda. Most importantly, it provides us granular information on the current status of existing residential and multifamily buildings in the city. However, because the data includes all buildings in Alameda, it was necessary for us to specifically attempt to select residential buildings using building codes. In the beginning of our analysis we went through the process of selecting specific residential buildings and working to divide them into two categories, single family building and multifamily building.

There is no standard definition for what constitutes a single family or multifamily building--so we outlined our decided upon description below. Residential buildings were identified by use code definitions that described buildings using words such as "house", "residential", or

"townhouse", etc., We included all residential buildings, including mixed-use buildings that may also serve commercial purposes (use code 3200 for example[51]).

After pulling out residential buildings, the second step was to identify which buildings should be classified as single family homes. This was an important distinction to make because Frontier Energy's cost-benefit analysis was based on single family housing. That information was also helpful in breaking down the housing stock. Codes placed in the single family building category were done so based on balancing two criteria: how closely they matched the characteristics of a detached building with the characteristics described in the Frontier Energy report and how likely they were to be owner-occupied.

Certain housing categories required some interpretation when classifying. For example, making the decision between how to delineate between the single and multifamily categories for townhouses, duplexes, and condos was difficult due to the fact that these types of buildings do not fall into either category perfectly. Our final decision was based on whether or not efficiency measures could be made by the resident of the unit as well as how similar the characteristics of the building were to a traditional, detached single family building. For our analysis we kept townhouses and duplexes in the single family housing classification because we felt they retained enough single family characteristics, such as individual appliances, heating, and roof as well as often being owner-occupied.

Detached homes have many interfaces with the outdoors–roof, walls, windows, and so forth. In a multistory condominium, a single dwelling unit is likely to have a wall, floor, or ceiling that is not interfacing with the outdoors, but with another unit, resulting in differences in insulation, air leakage, and other factors used in efficiency analyses. Therefore, in our analysis we classified condominiums as multifamily buildings because of the differences in efficiency. For example, replacing attic insulation would not benefit the units on the lower floors or duct sealing would have to be done for the entire building and not just one unit.

[51] See Appendix II for definition.

The full list of residential home codes and their descriptions can be found in Appendix Ⅱ.

After deciding on single versus multifamily home code definitions, the dates buildings were built were divided into four vintages, Pre-1978, 1978-1991, 1992-2010, and beyond 2011, according to the analysis by Frontier Energy which identified those dates based on building code changes and common materials used during that time period that would lead to differences in energy efficiency. These differences in building code and material changes between the vintages change the effectiveness of new efficiency measures in terms of cost-effectiveness and greenhouse gas reductions.

b. <u>Greenhouse Gas Estimates:</u>

After putting together the housing analysis for the City of Alameda, the next step was to create an estimate of carbon emissions reductions for different electrification and efficiency measures in the single family housing category. The estimate was built on an analysis conducted by Frontier Energy done for the City of Alameda. That analysis created individual carbon dioxide emission reduction estimates as well as cost-effectiveness estimates for a variety of efficiency and electrification measures. The estimates were also made for potential efficiency and electrification packages. Each efficiency and electrification measure was defined earlier in the report and below are three tables with the results from Frontier Energy's Analysis.[52]

[52] Frontier Energy, Inc., Misti Bruceri and Associates LLC, 2019. *2019 Cost-Effectiveness Study: 2020 Analysis of Low-Rise Residential Addendum – City of Alameda Analysis*. Alameda: Pacific Gas and Electric Company.

Table 7. Frontier Energy's single family efficiency upgrade cost-effectiveness results–Climate Zone 3.[53]

Measure	Vintage	Measure Cost ($)	Electricity Savings (kWh)	Gas Savings (therms)	GHG Savings (lb CO2e)	Utility Cost Savings		Customer On-Bill		2019 TDV		2022 TDV	
						Year 1	Avg Annual	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
R-49 Attic Insulation	Pre-1978	$3,332	151	33	359	$87	$72	0.58	-$1,569	0.67	-$953	1.40	$1,138
	1978-1991	$2,874	90	17	184	$47	$39	0.36	-$2,066	0.40	-$1,443	1.04	$98
	1992-2005	$2,333	58	6	65	$22	$18	0.20	-$2,088	0.19	-$1,504	0.22	-$1,438
Reduced Infiltration	Pre-1978	$1,474	10	14	143	$28	$24	0.43	-$944	0.65	-$1,182	0.63	-$552
	1978-1991		7	9	90	$17	$14	0.26	-$1,220	0.42	-$1,672	0.41	-$869
	1992-2005		4	6	57	$11	$9	0.17	-$1,378	0.26	-$1,733	0.24	-$1,114
Duct Sealing	Pre-1978	$683	40	30	315	$64	$54	2.12	$857	0.47	-$783	3.68	$1,832
	1978-1991	$683	18	17	175	$35	$29	1.15	$116	0.30	-$1,030	1.97	$659
	1992-2005	$423	4	5	48	$10	$8	0.51	-$234	0.20	-$1,186	0.72	-$118
New Ducts	Pre-1978	$3,986	77	54	567	$116	$97	0.65	-$1,553	2.59	$1,086	1.20	$781
	1978-1991		43	38	392	$79	$66	0.44	-$2,491	1.51	$348	0.79	-$826
	1992-2005		14	16	164	$32	$27	0.18	-$3,665	0.69	-$129	0.26	-$2,952
R-13 Wall Insulation	Pre-1978	$3,360	49	44	458	$90	$76	0.60	-$1,498	0.00	-$1,089	1.00	$10
Windows	Pre-1978	$9,810	100	27	309	$71	$59	0.16	-$9,247	0.20	-$7,843	0.50	-$4,916
	1978-1991		57	25	276	$57	$48	0.13	-$9,574	0.17	-$8,131	0.38	-$6,071
LED lamp vs CFL	All	$2.26	1.2	0	n/a	$0.21	$0.17	2.19	$2.69	n/a	n/a	n/a	n/a
Exterior photosensor	All	$42.58	12.1	0	n/a	$2.10	$1.66	1.17	$7.15	n/a	n/a	n/a	n/a

[1] Values in red and shaded grey indicate measures is not cost effective with a B/C ratio less than 1.

Table 8. Frontier Energy's single family efficiency packages cost-effectiveness results–Climate Zone 3.[54]

Measure	Vintage	Measure Cost ($)	Electricity Savings (kWh)	Gas Savings (therms)	GHG Savings (lb CO2e)	Utility Cost Savings		Customer On-Bill		2019 TDV		2022 TDV	
						Year 1	Avg Annual	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
R49 Attic & Air Sealing Package	Pre-1978	$4,806	111	47	511	$117	$97	0.54	-$2,484	0.60	-$1,902	1.09	$453
	1978-1991	$4,348	45	26	276	$64	$54	0.33	-$3,276	0.38	-$2,691	0.77	-$987
	1992-2005	$3,807	11	12	123	$33	$27	0.19	-$3,459	0.23	-$2,919	0.27	-$2,785
R49 Attic & Duct Sealing Package	Pre-1978	$4,015	127	61	651	$145	$121	0.81	-$868	0.96	-$163	1.60	$2,405
	1978-1991	$3,557	52	33	346	$79	$66	0.49	-$2,020	0.61	-$1,379	1.08	$299
	1992-2005	$2,756	10	11	113	$31	$26	0.25	-$2,325	0.32	-$1,871	0.35	-$1,797
R49 Attic, Air Sealing & Duct Sealing Package	Pre-1978	$5,489	138	74	788	$172	$143	0.70	-$1,859	0.82	-$963	1.34	$1,856
	1978-1991	$5,031	59	41	430	$95	$79	0.42	-$3,268	0.52	-$2,435	0.88	-$604
	1992-2005	$4,230	15	16	169	$42	$35	0.22	-$3,713	0.28	-$3,066	0.31	-$2,917
R49 Attic, Air Sealing & New Ducts Package	Pre-1978	$8,792	164	97	1,029	$220	$184	0.56	-$4,353	0.68	-$2,837	1.07	$598
	1978-1991	$8,334	79	60	632	$135	$113	0.36	-$5,981	0.46	-$4,505	0.71	-$2,427
	1992-2005	$7,793	24	27	279	$62	$52	0.18	-$7,205	0.23	-$5,969	0.26	-$5,789
Advanced Envelope Package	Pre-1978	$18,659	222	137	1,451	$302	$253	0.36	-$13,364	0.45	-$10,354	0.74	-$4,911
Water Heating Package	All Vintages	$208	n/a	n/a	n/a	$32	$394	1.68	$160	n/a	n/a	n/a	n/a

[1] Values in red and shaded grey indicate measures is not cost effective with a B/C ratio less than 1.

[53] *Id.*

[54] *Id.*

Table 9. Frontier Energy's single family efficiency packages cost-effectiveness results–Climate Zone 3.[55]

Measure	Vintage	Measure Cost ($)	Electricity Savings (kWh)	Gas Savings (therms)	GHG Savings (lb CO2e)	Utility Cost Savings		Customer On-Bill		2019 TDV		2022 TDV	
						Year 1	Avg Annual	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
Heat Pump at HVAC Replacement	Pre-1978	$1,555	-2,496	241	1,527	$1	$24	0.45	-$878	0	-$6,181	1.32	$501
	1978-1991		-1,895	178	1,030	$13	$26	0.50	-$807	0	-$5,781	0.78	-$340
	1992-2005		-1,651	164	793	$42	$48	0.89	-$171	0	-$3,779	1.06	$89
High-Effic. Heat Pump at HVAC Replacement	Pre-1978	$4,024	-2,284	241	1,624	$49	$62	0.44	-$2,319	0	-$7,423	0.85	-$613
	1978-1991		-1,737	178	1,104	$46	$53	0.38	-$2,581	0	-$7,354	0.54	-$1,852
	1992-2005		-1,524	164	850	$68	$69	0.49	-$2,106	0	-$5,502	0.57	-$1,748
Heat Pump at HVAC Replacement + 2.17 kW_{DC} PV	Pre-1978	$9,643	968	241	1,753	$456	$383	1.09	$912	0.92	-$789	1.35	$3,405
	1978-1991		1,569	178	1,256	$443	$366	1.04	$424	0.96	-$405	1.26	$2,550
	1992-2005		1,812	164	1,018	$453	$372	1.06	$592	1.17	$1,611	1.31	$2,988
HPWH at Water Heater Replacement	Pre-1978	$2,594	-1,308	164	1,378	-$43	-$19	0	-$3,467	0	-$3,565	1.31	$808
	1978-1991		-1,317	165	1,386	-$32	-$11	0	-$3,216	0	-$3,542	1.33	$845
	1992-2005		-1,320	165	6,211	-$35	-$14	0	-$3,312	0	-$3,539	1.28	$727
NEEA Tier 3 HPWH at Replacement	Pre-1978	$2,775	-986	163	1,488	$516	$422	1.02	$191	0.28	-$1,991	1.81	$2,249
	1978-1991		-990	164	1,500	$509	$416	1.00	$19	0.28	-$1,986	1.81	$2,249
	1992-2005		-993	164	5,883	$495	$404	0.97	-$327	0.29	-$1,963	1.76	$2,119
HPWH at Water Heater Replacement + 2.17 kW_{DC} PV	Pre-1978	$10,682	2,155	164	1,604	$516	$422	1.07	$791	1.19	$1,984	1.36	$3,885
	1978-1991		2,146	165	1,611	$509	$416	1.05	$619	1.19	$2,004	1.37	$3,916
	1992-2005		2,143	165	1,612	$495	$404	1.02	$273	1.19	$2,007	1.36	$3,798

[1] Values in red and shaded grey indicate measures is not cost effective with a B/C ratio less than 1.

Using these results from Frontier, we were able to estimate the cost and the carbon dioxide emission reductions of every single family home in the City of Alameda had the indicated efficiency and electrification measures installed. To get these estimates we multiplied each calculated value that Frontier Energy had for "Greenhouse Gas Savings" and "Measure Cost" by the number of single family homes per vintage. This created city-wide estimates of cost and greenhouse gas savings for different individual efficiency measures. These numbers are useful in comparing to each other to decide which efficiency measures the City of Alameda should prioritize when reaching out to single family homeowners.

Unfortunately, based on the data from the City of Alameda and the analysis done by Frontier Energy, no estimates were able to be made as to the amount of greenhouse gas emissions produced by multifamily housing in the City of Alameda. There was no analysis done of costs

[55] Frontier Energy, Inc., Misti Bruceri and Associates LLC, 2019. *2019 Cost-Effectiveness Study: 2020 Analysis of Low-Rise Residential Addendum – City of Alameda Analysis*. Alameda: Pacific Gas and Electric Company.

per measure or greenhouse gas savings for multifamily housing. Additionally, because multifamily housing includes everything from triplexes to high-rise apartment buildings and condominiums the estimates made by Frontier Energy for single family dwellings are not equivalent. Multifamily dwellings also do not require the same sort of efficiency and electrification retrofits. For example, R49 attic insulation has very little to no impact on an apartment that is not on the top floor of a multistory apartment building.

c. Points of Intervention Analysis

i. Point of Sale

To get a sense of the potential effectiveness of policies that might include point of sale as an intervention point, we analyzed 22 months of transfer tax data for the City of Alameda. The 22 specific months used were from July 2017 through June 2019. Each month of transactions was summed excluding duplicates for a total number of transactions that month. These totals were then used to find an average number of transactions per month. Because the single family category developed for this report does not include all potential deed transfers, an adjustment was made to try and account for this imperfect delineation. To make the adjustment, the following building use codes 2100, 2500, 2600, 2700, 7300, 7390, 7700 were summed and then taken as a percentage of their total plus the single family building total. This percentage was then deducted from the average monthly number of deed transactions that was calculated previously. This new number was then divided by the total number of single family buildings and twelve months to get the estimate of the number of years it will take for all of the single family homes to be exchanged. It should be noted that this estimate has not accounted for people who flip houses or live in their houses for 30 years at a time, but this number still provides a reasonable estimate of the time period in which a significant portion of the City of Alameda's single family building stock will change ownership.

ii. Point of Permit

The other potential intervention point considered was during the permitting process. To analyze the potential impact of policies that include interventions during the permitting process, two years of permit data from the City of Alameda analyzed. The 2019 C404 report and the 2020 C404 report were used to determine a variety of descriptive statistics about single family residential permits. To get these numbers, Construction Type Codes 101, 102, and 434 were analyzed for any single family housing permit issued and the estimated job value was then recorded. The numbers were then used to determine the average number of permits issued per year for single family homes as well as the average and median job value estimate for single family homes. Additionally, the range and 1st and 99th percentile were calculated for the combined two years of permit data for the Construction Type Codes listed above.

VIII. Results

a. Housing Analysis

There are 18,868 buildings in the City of Alameda, 17,470 (or 92.5 percent) of those buildings are residential buildings. The results of the comprehensive analysis by building type divided into single and multifamily buildings are as follows. There are 17,470 residential buildings, of which 15,088 (approximately 86 percent) are single family houses, and 2,382 are multifamily buildings (approximately 14 percent, households are around 14,697). If you divide this into the years in which the building was built, most of the single family and multifamily buildings were built before 1978, with the fewest buildings built in the last decade. This is important because any building built before 1978 will see the biggest returns in terms of cost savings to the owner and greenhouse gas emission reductions.

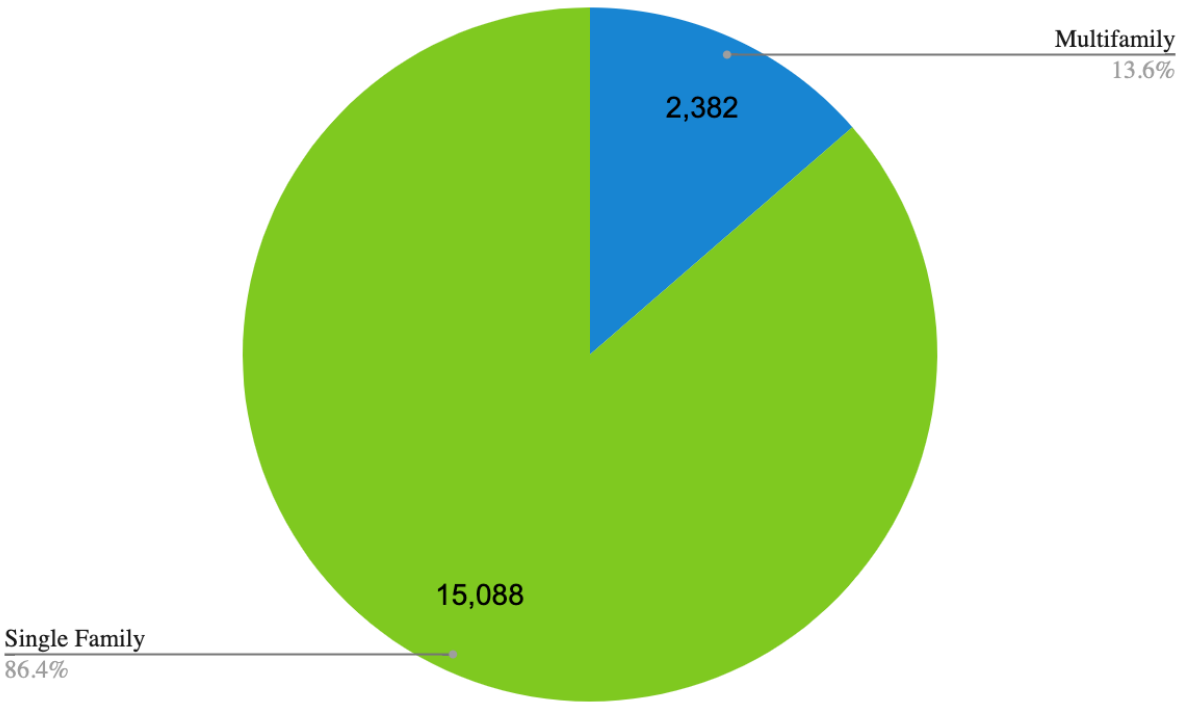


Figure 2. Breakdown of the number of residential buildings in the City of Alameda. *This chart shows the breakdown of Alameda's residential buildings between single family homes and multifamily buildings. Single family homes account for a significant portion of residential buildings as well as total buildings citywide.*

When we look further at the characteristics of each building type, the average area of a detached house was 1,732.41 square feet with an average of 2.99 bedrooms and 1.01 households living there. In comparison, the average area of multifamily housing with 6.17 units is 5,108.45 square feet, and if divided into the number of households, it is estimated that each household accounts for about 827.95 square feet. Multifamily homes have an average of 7.77 bedrooms (1.26 per household). A table with a detailed analysis of each building code can be found in Appendix III. It could be utilized in the future if the building code-specific characteristics need to be reflected in the cost-benefit analysis and GHG emission reduction estimation process.

Table 10. Analysis of existing residential buildings in the City of Alameda.

Type	Year Built	Number	Square Footage	Bedrooms	Units
Single	NONE	483	329.89	0.61	0.22
	pre-1978	10,421	1,645.03	2.99	1.06
	1978-1991	2,654	1,984.98	3.03	1
	1992-2010	1,426	2,326.00	3.62	0.99
	2011~	104	2,417.13	3.75	0.37
	Total	**15,088**	**1,732.41**	**2.99**	**1.01**
Multi	NONE	571	7,713.53	12.29	8.99
	pre-1978	1,782	4,245.02	6.35	5.26
	1978-1991	20	3,873.30	7.8	6.85
	1992-2010	8	14,875.00	3.88	6.5
	2011~	1	2,814.00	6	2
	Total	**2,382**	**5,108.45**	**7.77**	**6.17**

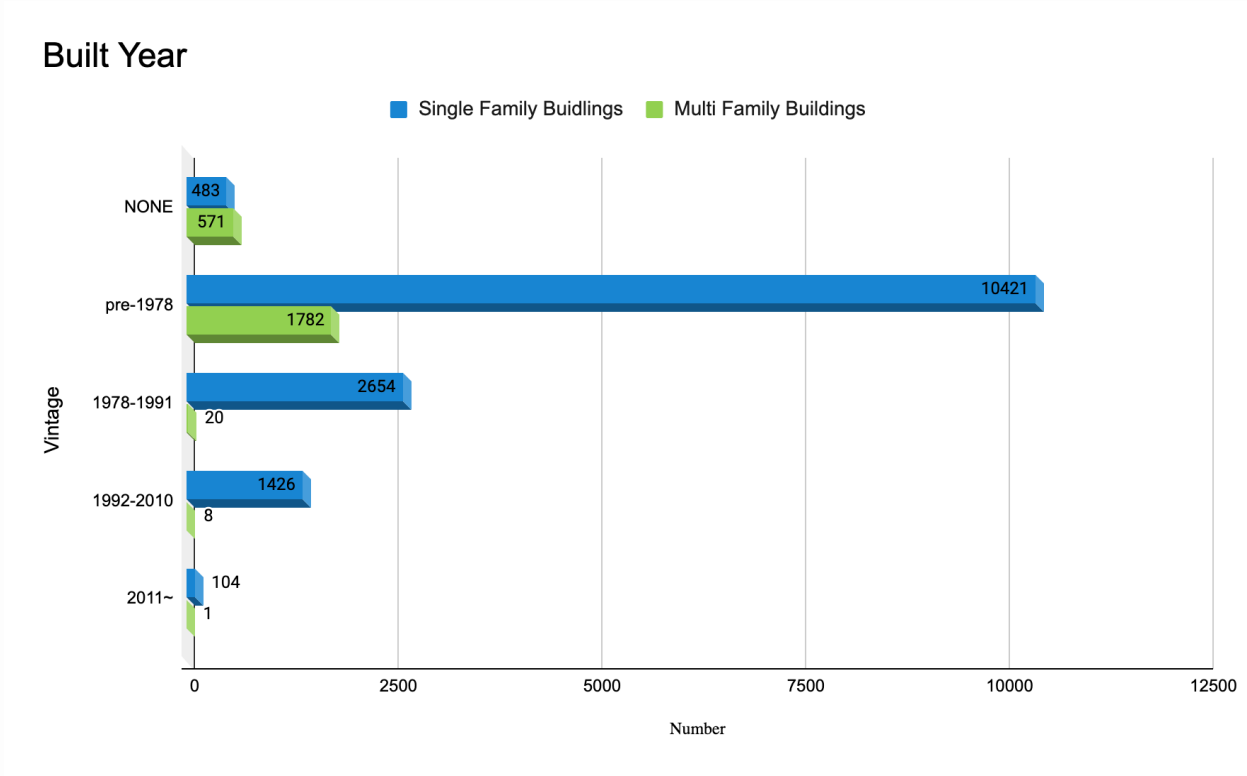


Figure 3. Breakdown of the City of Alameda's residential buildings by year built. *This chart shows the breakdown of Alameda's residential buildings between single family homes and multifamily buildings and*

what year it was built. For both single family homes and multifamily buildings a significant portion were built before 1978.

In the case of single family detached houses, the housing code with the most buildings is 1100 (single family homes used as such), which recorded a total of 9,913 buildings, followed by 1800 (SFR-Planned Development Tract with Common Area) and 1500 (Townhouse - Planned Development) with 2,084 and 1,529 houses respectively. We find most of the single houses are three types of buildings with about 89.65 percent of the total single family building accounted for. For multifamily houses, the difference between building codes is not as extreme compared to the case of detached houses. Code 2500, 7700 and 2100 appear to be the most common in multifamily housing, with 551, 436 and 270 houses, respectively.

One important thing to take into account is the dichotomy between the number of *buildings* and the number of *units* that single and multifamily residences comprise. Despite a majority of the buildings in Alameda being single family residences, there are 14,697 total units in multifamily buildings. When combined with single family buildings, there are about 29,785 total housing units in Alameda. This is a critical piece to recognize. Simply focusing on single family housing will miss almost 50 percent of the people living in Alameda, but will target 86.4 percent of residential buildings. It will be much harder to see significant gains among single family homes because the decarbonization work being done is a piecemeal process–making any gains diffuse and requiring that many individuals make changes for gains to become significant. This challenge is important to recognize and consider in any decarbonization plans going forward.

b. Cost and Greenhouse Gas Emission Reduction Estimates

Using the methods detailed above we were able to calculate total cost estimates and total greenhouse gas emissions estimates for individual electrification and efficiency measures. Essentially, we were able to estimate the cost and the carbon dioxide emission reductions if every single family home in the City of Alameda had the indicated efficiency and electrification measures installed. For the full results of every individual measure see Appendices V and VI.

Unfortunately, because of the climate zone the City of Alameda is located in, many of the efficiency measures do not pass the cost-effectiveness analysis done by Frontier Energy. However, there is some good news. There are a few electrification and efficiency measures that pass the cost-effectiveness analysis and if fully implemented would achieve Alameda's 2030 carbon emission reduction goals. The measures that were cost-effective are listed in Table 10 below. The one caveat is that we used 2022 time-dependent valuation (TDV) parameters from the Frontier Energy report for cost-effectiveness, which have yet to be adopted by the State of California. If the TDV 2022 methods are not adopted most measures will no longer be cost-effective, which means that any efficiency or electrification measures would likely have to be voluntary.

Based on these results, focusing on heat pumps and water heaters will be the most effective in terms of the city achieving its 2030 carbon emission reduction targets. Additionally, 50-75 percent of the goal could be met by strongly pushing for three efficiency measures: R-49 attic insulation, duct sealing, and R-13 wall insulation. Likely the most effective results would be achieved by requiring some combination of heat pumps, water heaters, and the three efficiency methods.

The last column in Table 11 shows the total greenhouse gas emission reductions in tons if individual electrification and efficiency measures were applied to all single family buildings in the City of Alameda. Unfortunately, these numbers cannot be stacked in any meaningful way because once one measure is complete it affects reductions from other measures. For example, installing a heat pump at HVAC replacement means that R-49 attic insulation no longer has any emissions reductions associated with it. While the R-49 attic insulation will decrease overall energy usage it will not affect emissions because AMP currently delivers 100 percent carbon-free energy.

Table 11. Breakdown of cost-effective measures by total citywide cost, average annual savings and greenhouse gas emissions reductions.[56]

Measure	Vintage	Number of Single Family Buildings	Individual Measure Cost	Total Cost of Measure	Average Individual Annual Utility Cost Savings	Utility Bill Cost Savings Citywide	Total GHG Savings in Tons
R-49 Attic Insulation	Pre-1978	10421	3,332	33,186,720	72	879,486	2,161
	1978-1991	2654	2,874	7,636,218	39		
	1992-2010	1426	2,333	3,322,192	18		
Duct Sealing	Pre-1978	10421	683	6,802,680	54	651,108	1,908
	1978-1991	2654	683	1,814,731	29		
	1992-2010	1426	423	602,352	8		
R-13 Wall Insulation	Pre-1978	10421	3,360	33,465,600	76	791,996	2,386
	1978-1991	2654	0	0	-		
	1992-2010	1426	0	0	-		
R49 Attic & Duct Sealing Package	Pre-1978	10421	4,015	39,989,400	121	1,473,181	3,117
	1978-1991	2654	3,557	9,450,949	66		
	1992-2010	1426	2,756	3,924,544	26		
Heat Pump at HVAC Replacement	Pre-1978	10,421	1,555	15,487,800	24	648,442	9,889
	1978-1991	2,654	1,555	4,131,635	26		
	1992-2010	1,426	1,555	2,214,320	48		
HPWH at Water Heater Replacement	Pre-1978	10421	2,594	25,836,240	-19	-247,157	13,448
	1978-1991	2654	2,594	6,892,258	-11		
	1992-2010	1426	2,594	3,693,856	-14		
NEEA Tier 3 HPWH at Replacement	Pre-1978	10421	2,775	27,639,000	422	6,077,830	13,938
	1978-1991	2654	2,775	7,373,175	416		
	1992-2010	1426	2,775	3,951,600	404		

Additionally, because not all of the building types categorized in the single family housing category are detached, our greenhouse gas reduction estimates could be slightly overestimated. This overestimation arises because of the difference between the way a detached single family home and multi-unit or multi-story buildings interact with their external environment.

[56] Cost effectiveness, utility bill savings, and greenhouse gas reductions used from: Frontier Energy, Inc., Misti Bruceri and Associates LLC, 2019. *2019 Cost-Effectiveness Study: 2020 Analysis of Low-Rise Residential Addendum – City of Alameda Analysis*. Alameda: Pacific Gas and Electric Company.

Table 11 also shows the total cost for all of the City of Alameda if individual electrification and efficiency measures were individually applied to all single family buildings. These numbers also cannot be combined in any meaningful way because it is hard to predict in what fashion these measures will be applied and once one is applied others may not, for example, if a homeowner decides to seal all the ducts in their house it is unlikely that they will then turn around and get new ducts. The one number to keep in mind is from 2019 CARP, which estimated that it may cost $900 million to fully decarbonize the City of Alameda's existing building stock.[57]

c. Points of Intervention

i. Point of Sale

We analyzed twenty two months of records of deed transfer data and found that there are approximately 1,989 home sales in Alameda per year. This number is dependent on the current status of the housing market, but we believe that barring an extreme swing in the economy, this estimate can be loosely used to predict how a point of sale intervention policy may behave. Furthermore, it should be noted that this estimate has not accounted for people who flip houses or live in their houses for 30 years at a time. Given this number, if Alameda implemented a point of sale requirement for single family homes, it would theoretically reach all of the single family homes in approximately 9-10 years (after adjustments noted in the methods section are made), making it a potentially very effective point of intervention.

Obviously, there are a few caveats to this number. This number is an average, with some homes cycling very quickly between owners and some remaining in the same hands for many decades. These considerations are addressed when points of intervention are recommended. The point of sale intervention–though the estimates are loose–is an extremely promising intervention point for single family homes. An important note is that implementing a point of sale policy will require outreach to the realtor community, and having their support or

[57] *Alameda Climate Action and Resiliency Plan (CARP)*. 2019. Alameda: City of Alameda. Available at: <https://www.alamedaca.gov/files/sharedassets/public/public-works/climate-action-page/new-folder/final-carp-9-2019/alameda_carp_final_091119noappendices.pdf ` > pg41

agreement with such a measure will be crucial. See further breakdown of the data in Appendix I.

ii. Point of Permit

We used two years of Alameda construction permit data in order to understand how effective the point of permit policy intervention point may be. We found that there are about 2,781 permits issued per year for single family residences and that the median permit value falls at $6,000 and the 90th percentile is $26,500. There are two caveats to our estimate. First, it does not account for houses that pull multiple permits for several different projects in one year. Second, this estimate is unable to completely differentiate between the few homes, such as condominiums, that are included in the multifamily part of our analysis, but still may be issued a construction type code 434 permit.

Table 12. Descriptive statistics of constructions permits for the City of Alameda.

	C404 2019	C404 2020	Total (average of 19/20 combined data)
Average Permit Value	$16,398.55	$21,199.02	**$18,443.19**
Permits Issued	3193	2369	**2781**
Total Value of Permits Issued	$52,360,578	$50,220,470	$102,581,048
Minimum Permit Value	$0	$0	$0
Maximum Permit Value	$3,135,700	$19,186,511	$19,186,511
1st Percentile	$0	$0	$0
10th Percentile	$500	$520	$500
25th Percentile	$1,000	$1,000	$1,000
Median Permit Value	$6,450	$6,000	**$6,000**
75th Percentile	$13,500	$13,500	$13,500
90th Percentile	$26,500	$26,500	**$26,500**
99th Percentile	$150,000	$150,000	$150,000

Piedmont uses the 90th percentile of permit prices as a trigger point for requiring a weatherization or efficiency project.[58] However, with a 90th percentile upwards of $25,000 and a 10th percentile at $500, Alameda's spread of permit prices are so broad that it makes choosing an effective point of permit price for policy trigger challenging. Requiring homeowners who exceed the 90th percentile of permit prices to complete projects will not impact very many homes per year, and therefore will likely be fairly ineffective as an intervention point, but the median permit value of $6,000 is low enough that requiring weatherization of electrification projects at that point would basically double the cost of the permit likely making an intervention at that point too onerous a requirement.

IX. Recommendations

Our team's recommendations come from a synthesis of both our observed data and findings as well as from the lessons to be learned from relevant case studies and decarbonization reports. While we deem these recommendations the best pathway towards decarbonizing Alameda, city staff and elected officials who are more familiar with the political landscape or after consultation with stakeholders may decide on a different course. In that event, our analysis of the full menu of technical weatherization and electrification, finance structures, and points of intervention should prove helpful regardless of the decarbonization path chosen. Furthermore, due to the magnitude of the challenge of decarbonizing existing buildings, we believe that no matter what path the City of Alameda decides to pursue a combination of solutions will be needed in order to hit carbon goals. Each financing mechanism and intervention point can be

[58] Piedmont.ca.gov. 2021. *Reach Codes*. [online] Available at: <https://piedmont.ca.gov/government/city_news___notifications/reach_codes>

used individually or combined to create a decarbonization strategy, and the carbon reduction estimates and housing analysis should prove useful for any final pathway chosen.

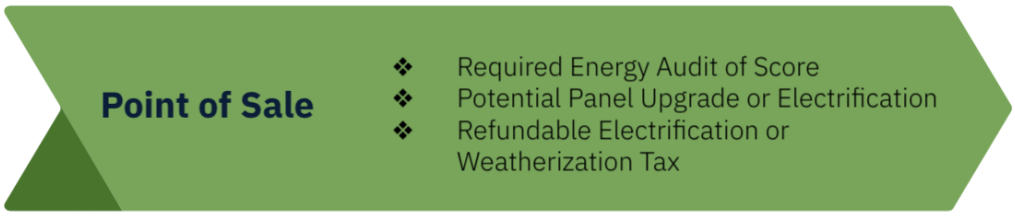
a. Recommended Points of Intervention

One of the main challenges of decarbonizing existing buildings is that there is no single policy that will reach every existing home in Alameda. Because of this, we recommend the City of Alameda take advantage of every point of intervention available, which will increase the chances that every home (particularly single family) will qualify for a point of intervention and be required to implement a decarbonization policy.

i. Point of Sale

As we mentioned in the results, the point of sale intervention point is extremely promising. Based on our analysis, single family homes in Alameda are constantly cycling through the market at a reasonable pace of nearly 2,000 per year.[59] Due to this rate of sales, we are recommending several potential electrification and efficiency measures that the City of Alameda could require at the point of sale.

First, we are recommending an electrical panel upgrade at sale. While panel upgrades can be expensive, they are crucial to preparing a home to be fully electrified. Panel upgrade rebates are some of the highest AMP already offers, which reduces the financial burden of this requirement. According to Home Advisor, the upper end of the cost of a panel replacement is $4000, with the average range being between $750-$2000, combined with AMP's rebate of $2500, home sellers in most cases will not have to pay anything and in some cases may have to add $1500, which is not likely to be a



[59] DeVries, A., 2021. *The Alameda County Real Estate Report*. [online] Rereport.com. Available at: <https://rereport.com/alc/index.html>.

large percent of the final sale price of the house and we believe could be priced into the sale.[60] Two of the current biggest barriers to electrification are ease and speed. Currently, when an appliance breaks down or a homeowner is looking to upgrade, they may choose to forego electrification if they discover that the new electric appliance is going to add time and cost simply because their panel is outdated. This policy alone could get nearly every single family home in Alameda fully prepared for electrification in eight to ten years.

A potential financing mechanism at the point of sale that we recommend Alameda emulate is the City of Berkeley's earthquake preparedness tax by creating a similar Refundable Electrification Transfer Tax. By levying a refundable tax on the sale of the home which can be reimbursed upon completion of an efficiency project chosen from the list we have provided, Alameda can ensure that every time a home changes hands, it comes one step closer to full electrification. One specific part of the tax that we think is important, especially for getting the realtor community on board, is allowing a grace period of six months to a year from the time of closing for the retrofit to happen. This grace period would allow the sale of the house to be completed without any additional burdens while still completing a retrofit.

We also see the City of Alameda as having two paths within a point of sale intervention. The first, which we outlined above, would require installation of electrical panels at sale. This path would not lead to a large amount of carbon emission reductions, but it would prepare the city for future decarbonization actions. Ten years from now all houses would be prepped for electrification. Most likely gas prices will have risen and electric appliance prices would have come down. This sets up a scenario where an updated point of sale requirement could be quite effective. The second path would be rather than requiring a panel update, the City of Alameda aggressively tries to meet its 2030 carbon reduction goals in the housing sector by requiring an

[60] Homeadvisor.org. 2021. *How Much Does It Cost To Upgrade Or Replace An Electrical Panel?* [online] Available at: <https://www.homeadvisor.com/cost/electrical/upgrade-an-electrical-panel/#:~:text=Average%20Cost%20to%20Upgrade%20an,%242%2C000%20for%20their%20project%20labor>.

electrification or efficiency at the point of sale. Based on our results above, it is highly likely Alameda could achieve its 2030 goals if the city were to require either a conversion from a gas furnace or water heater to a heat pump or heat pump water heater at the point of sale. By requiring either of these options, Alameda would likely easily meet its 2030 goals.

Finally, we strongly recommend that every home, both single family and multifamily residences have a mandatory energy score or energy audit performed at the point of sale or leasing. There are numerous providers of this service that can be found via the Department of Energy's Better Buildings page, and the cost can usually be rebated.[61] In the Bay Area, BayREN provides a home energy score with a $200 rebate.[62] This policy is key to equity considerations for Alameda and is multi-beneficial. It may lead homeowners to be motivated to do upgrades on their own, and gives renters some knowledge about a potential lease. Additionally, it serves as a natural point of outreach and education to homeowners and renters by making them aware of their own home's efficiency and the money and energy they could be saving through electrification and upgrades. It also gives some autonomy to renters who may be able to avoid buildings and rental units that have particularly high energy bills.

These audits can also be used to reward homeowners who have already put significant effort into electrification or efficiency retrofits for their homes by exempting them from the mandatory point of sale efficiency projects. For example, in Piedmont's reach code it allowed an exemption from any point of sale requirements for any homeowner whose house scored a seven or above on a home energy score.[63] We recommend a similar exemption for Alameda as a way to address concerns that have been raised in other cities working on this issue and hopefully ease the political process and stakeholder outreach.

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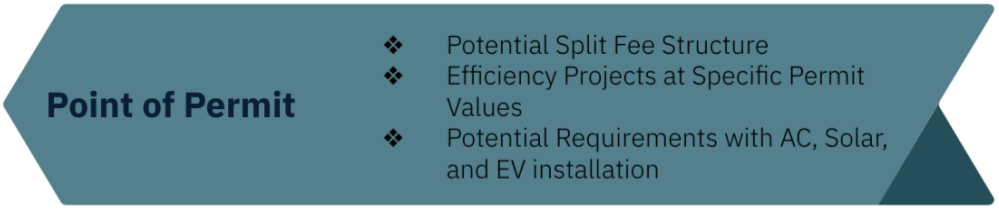
[61] Energy.gov 2021. *Find Assessors with our Tool* [online] Available at: <https://betterbuildingssolutioncenter.energy.gov/home-energy-score/home-energy-score-partner-map>.
[62] BayREN.org. 2021. Home Energy Scores. [online] Available at: <https://www.bayren.org/hes>.
[63] Piedmont.ca.gov. 2021. *Reach Codes*. [online] Available at: <https://piedmont.ca.gov/government/city_news___notifications/reach_codes>.

ii. Point of Permit

As we mentioned, not every home cycles through the market quickly. Many people live in their home for decades without selling. These homes will be missed by a point of sale intervention and require a different policy intervention. One potential point of intervention that could be utilized is construction permitting. Not only does intervention at this point potentially reach homes that are not impacted by the point of sale intervention, but it also provides an opportunity to utilize retrofits that work in harmony with the work being proposed. We found that Alameda grants almost 3,000 permits per year, so depending on how they are utilized, permits could be a very successful point of intervention. Furthermore, we recommend a change in the structure of permit fees themselves, which exist outside of permit project value.

Alameda's construction permit job value range is broad. Nearly $20,000 separates the median job value ($6,000) and the 90th percentile (~$26,000). A policy implemented at the point of permit–even at the 90th percentile–would be successful at getting to some of the more expensive homes that people would rather remodel than move out of, as well as still reaching close to 20 percent of the single family homes in Alameda within a decade. Additionally, large multifamily buildings do not change hands very often and point of permit may be a perfect time to require retrofits. Picking a trigger price will be an important part of this policy and will likely require significant stakeholder outreach and engagement.



We recommend that at the point of permit Alameda requires an efficiency or electrification retrofit at some sort of permit value threshold. Homeowners would be able to choose from the same electrification and efficiency retrofit list from earlier in the report at the point of sale.

Because remodels on multifamily homes are typically performed by landlords, this policy can be a way to ensure multifamily homes are not left behind. Tenant protections would have to be implemented so there is no fear of burdening low-income families.

Required projects done at the point of permit also open opportunities for synergistic efficiency projects. For example, if a home is looking to remodel an upper story, it may be a natural time to install attic insulation or new energy-efficient windows. The City of Piedmont's reach code requires that if work is being done in the kitchen or laundry area, new outlets must be installed to prepare for future electrification.[64] A similar requirement could be set when work is being done in areas that include furnaces, boilers, or water heaters.

Similar to these synergistic projects are project requirements at the point of air conditioning, solar, or electric vehicle charger installation. We recommend that when a single family home installs any of these amenities, they also will be required to choose from the list of electrification and weatherization projects. Alternatively, Alameda could mandate specific efficiency projects for specific installations. For example, when a homeowner is installing air conditioning they could be required to install a heat pump, and at solar or EV charger installation there could be panel upgrade requirements. Furthermore, these projects indicate that the homeowner most likely plans to reside in the home for a while, which means the building might be missed by point of sale requirements.

Finally, we recommend the permit fees themselves should be reworked in order to benefit electrical system projects, and penalize gas projects. The goal of this policy is to raise the cost of certain gas system projects that may not be worth the remodel and to encourage those people to switch over to all-electric appliances. If there are equity concerns about a split fee structure, Alameda residents who need to fix a gas system but cannot afford to fully switch

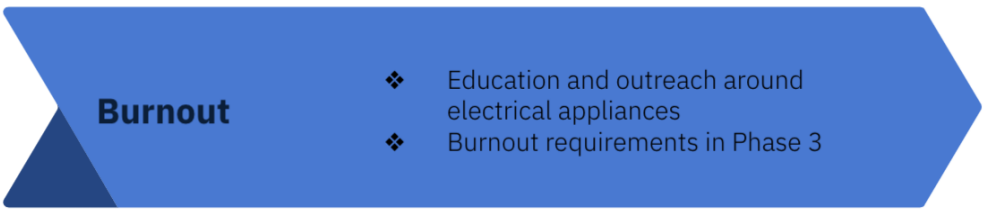
[64] Piedmont.ca.gov. 2021. Reach Codes. [online] Available at: <https://piedmont.ca.gov/government/city_news___notifications/reach_codes>.

over to electric can be solved by income exemptions or rebates/vouchers that bring the heightened permit fee back to the earlier level.

iii. Burnout

Burnout is a challenging point of intervention for two reasons. First, when it happens it usually creates a situation that people want remedied immediately, meaning appliance replacements are usually "like-for-like."[65] Second, there is still a lack of knowledge around the options a consumer has related to new electric appliances, water heaters, or furnaces–and it does not appear that contractors are attempting to change that. For these reasons, our recommendations are mainly to increase education and outreach to the residents and contractors of Alameda. Consequently, when residents reach the point of burnout for an appliance, they know to look for electric and efficient replacements.

It would likely be untenable to attempt to reach a consumer in the couple of days between when their water heater breaks down and when they have bought and installed a new one. Additionally, if requirements were put on permitting for emergency replacements it would likely lead to a large uptick in permit avoidance rather than actual adherence to the requirements. Additionally, the education and outreach angle has the added benefit of avoiding some of the gas stove controversies. By delaying requirements around electrification of gas stoves at burnout and focusing more on outreach and education, Alameda can buy time while the price of induction stoves continues to drop and they become more widely recognized as viable replacements. Initially with burnout, avoiding the implementation of any sort of mandates or requirements is likely the best path forward. Efforts

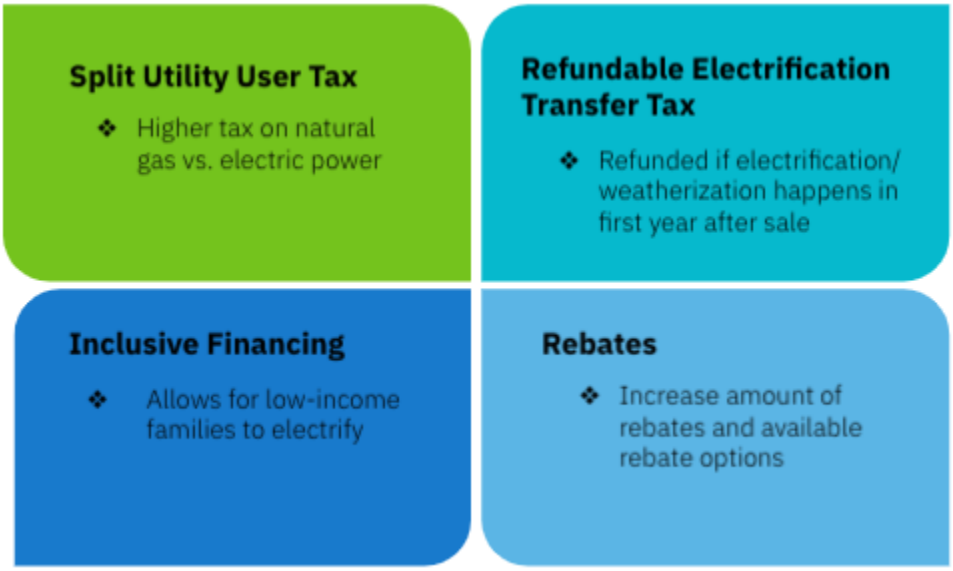


[65] A gas appliance is replaced with a gas appliance and an electric appliance is usually replaced with an electric appliance.

should be focused on ensuring that a consumer has been made aware of the cost, health, and resiliency benefits of electrifying their appliances as well as their city's efforts to move to all-electric power and to weatherize buildings. These outreach and appeals campaigns will hopefully make homeowners and contractors more likely to purchase a more efficient or electric unit of their accord.

b. Recommended Financing Mechanisms

As we noted with the points of intervention, no intervention is the perfect policy that will reach all buildings. A similar problem arises with financing. Electrification is happening at too slow of a pace, and one major reason is that despite the fact that the economics might pencil out over the lifetime of an appliance or retrofit, the upfront costs of electrification are still significant and can be a barrier. This is a concern for the speed of transition as well as for equity. Not only that, but these upfront costs are dispersed across 93 percent of the existing buildings, making this an extremely diffuse problem.



In order to make the above policy interventions work–and work equitably–it will require creative financial solutions for the consumer, for the utility, and for the city. To be clear, having financing that is easy to use and available to everyone is a key component of ensuring an equitable transition and we have selected a handful of financing mechanisms that we believe will significantly help ease the burden of paying for the transition from natural gas to electricity.

i. Split Utility User Tax

As explained earlier, utilizing a split utility user tax will help naturally shift Alameda residents from using gas power to using more electricity. By making the use of natural gas more expensive, the taxes help reflect the negative externality of carbon produced by burning natural gas. While it is good to help realize the true cost of natural gas use, more importantly, a split utility user tax could be used to create a climate or green fund to be put towards hiring a city staffer who solely focuses on decarbonization, funding pilot projects in multifamily houses, or even simply as capital for rebates or low-interest loans for residents of Alameda who want to electrify or make efficiency upgrades.

One of the common themes we heard, especially for multifamily housing, is that the electrification world is prohibitively complicated. It is challenging for the average person to attempt to navigate the world of construction, financing, and multiple levels of rules and regulations.[66] We believe hiring or repurposing a city position as an electrification technical advisor who knows the ins and outs of these areas could provide excellent guidance to homeowners, multifamily building owners or managers, renters, or contractors. This was particularly an issue raised in the multifamily housing world, which brings up equity considerations. In addition, this staffer could coordinate education and outreach campaigns with stakeholders in the community such as homeowners associations, churches, business groups, etc. For now, BayREN offers a free consultation to homeowners, renters, or multifamily building owners with a PG&E account and we recommend that their resources and contact be included in any education or outreach. In the future, AMP has plans to create energy advisor positions which should also be highly promoted.

[66] *Prioritizing California's Affordable Housing in the Transition Towards Equitable Building Decarbonization*. 2021. California Housing Partnership. Available at: <https://1p08d91kd0c03rlxhmhtydpr-wpengine.netdna-ssl.com/wp-content/uploads/2021/04/BuildingDecarbonizationSummitAHReport2021.pdf>.

ii. Refundable Electrification Transfer Tax

The decarbonization benefits of this tax were explained earlier as a part of the point of sale intervention. However, this strategy is also a powerful financing mechanism. The initial tax on the new homeowner encourages them to pursue electrification projects for their new home that match their specific home and lifestyle. However, if they decide to not electrify, the tax is no longer refundable and could be put in the same fund as the split utility user tax to help other residents electrify. In this way, regardless of how the new homeowner decides to react to the new tax, funds can be used to electrify a building in Alameda.

iii. Inclusive Financing

It will be crucial to provide up-front cost support to Alameda residents looking to electrify, and we identified two options for this: on-bill financing or inclusive financing. We believe that inclusive financing is the preferred financing option for several reasons. First, inclusive financing is more explicitly focused on equity of financing than on-bill financing. Second, as we described earlier in our report, inclusive financing allows for immediate savings for the consumer, is tied to the meter where the upgrades are made allowing renters access to the program, and requires no upfront capital on the part of the consumer. Finally, this is not a loan to customers, it is a tariff that the utility is allowed to recover costs on, which is an important distinction. There is still the requirement to pay off the cost of the investment on the part of the customer, but the utility is the one who negotiates for the upfront capital, potentially with a third party. This results in a situation where rather than having to demonstrate good credit, potential participants in the program only need to demonstrate a good payment history on utility bills.

Inclusive financing also has the potential to mitigate some of the challenging dynamics that might arise in multifamily buildings. Because all customers will see savings immediately with no upfront cost, they may be more likely to agree to the electrifications or retrofits. Additionally, building owners will see investments in their building and potentially even an

improvement in reputation for being willing to improve apartments and reduce utility costs. Also, because the renters will be paying back the cost of the upgrades through a tariff on their bill, it eliminates some of the split incentive concerns related to multifamily housing electrification and retrofitting measures, because while renters will be paying for the upgrades they will also be experiencing 20 percent of the savings and therefore incentivized to take action. Because renters are paying for the upgrades to the multifamily buildings we believe it would be reasonable to ensure there is some sort of tenant protection against building owners increasing rent. For all these reasons we believe inclusive financing has the potential to be very successful and to be effective in multifamily buildings, which is difficult but crucial to an equitable transition.

iv. Rebates

Rebates are both simple and proven to be effective financing mechanisms and are one place that we feel the City of Alameda and AMP have made good progress. Based on AMP's beneficial electrification plan, we support much of what they are already doing–as well as their plans for expansion. However, we do recommend building on the existing and proposed AMP rebate structure to both increase the amount offered for rebates and for what can be rebated, particularly for efficiency retrofit projects–such as duct sealing and insulation (which currently do not exist and none were proposed in the Beneficial Electrification Plan).[67] We also believe that AMP and the City of Alameda should place a greater emphasis on educating residents that stacking of rebates through BayREN and AMP is an option.

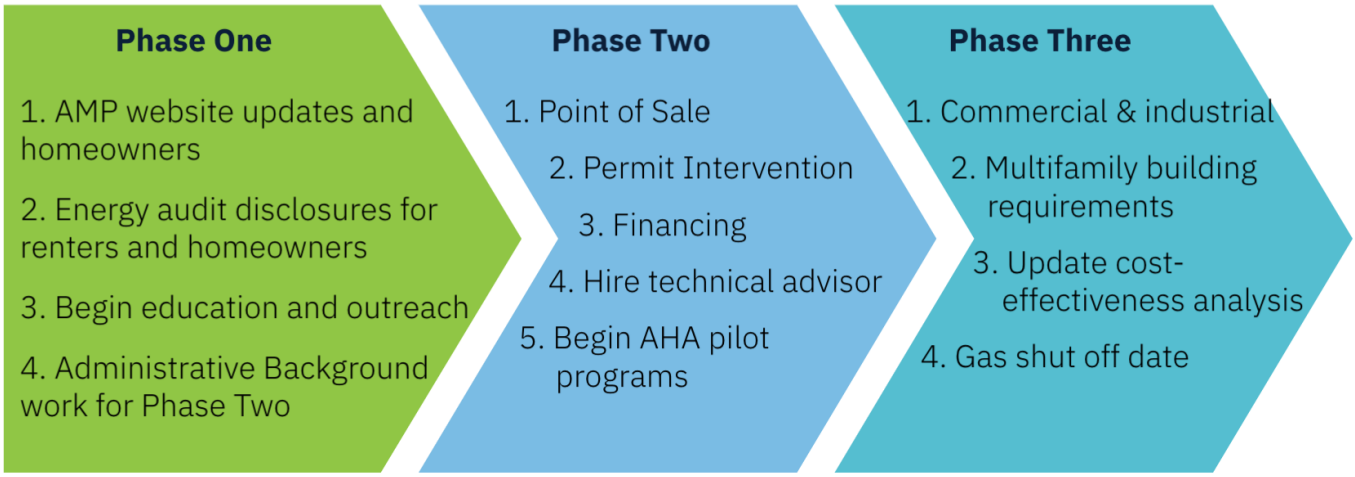
It is clear that Alameda residents already have some knowledge about the rebates available to them, proven by the interaction that AMP already sees with its rebate program. And, as AMP representatives mentioned, when they increased the rebate amount for heat pump water heaters, utilization of the rebate program increased. So any additional rebates or increases will

[67] Irwin, R., 2021. *For Information Only, Beneficial Building Electrification Customer Programs Proposal*. [online] Alamedamp.com. Available at: <https://www.alamedamp.com/AgendaCenter/ViewFile/Item/7363?fileID=3819>.

be immensely beneficial. Furthermore, as people are required to perform efficiency projects on their home at the various points of intervention mentioned above, they may need help financing them. Rebates offer a simple solution to provide that help. When considering how to expand or set rebate levels, we recommend AMP look to Sacramento Municipal Utility District for direction. The success of that program can serve as a blueprint for a similar system in Alameda. While expanding and adding to the rebate structure may be more expensive for AMP, the increase in revenue from the added load residential electrification represents for AMP should help incentivize cooperation or be reason enough for the PUC to justify requiring AMP to add financing options or expand rebates.

c. Decarbonization Phases

Up until this point we have recommended a variety of wide-reaching decarbonization strategies. To help organize our recommendations and provide a different angle on our decarbonization plan, we have developed three phases that can be executed in order to build sequentially towards a fully decarbonized Alameda. As speed is of utmost importance, these phases do not have a specific timeline attached to them nor should they be understood as mutually exclusive. Each phase has a different focus that will bring the city closer to full building decarbonization.



i. Phase One

The first phase of decarbonizing existing homes in Alameda focuses on education and outreach, additional groundwork and research, as well as implementing some of the simpler, less costly goals.

During phase one, we recommend that Alameda Municipal Power update its website with as much decarbonization information as they can provide (which is already in the works) and we want to acknowledge that as a good first and important step. AMP's current customer outreach methods can also be used to alert Alameda residents of the upcoming policies. There are a handful of outreach mechanisms that we believe can be leveraged by AMP and the city to successfully educate residents of Alameda about the upcoming policy changes and the city's goals. These include bill inserts (both physical and digital), the Electrify Alameda website, and the finalization of AMP's proposal to hire a staffer to work on consumer education about Alameda's electrification goals.[68,69]

We also recommend that the city immediately begin the work of developing and implementing energy score or audit disclosure requirements at the point of sale for all homes as well as for the leasing of multifamily units. The disclosures and audits are a key piece of base knowledge on which future electrification and efficiency requirements will be based. The audits for homeowners can also be a form of education for homeowners on what electrification and efficiency measures are necessary for their home and what could be required if a future efficiency or electrification requirements are implemented at the point of sale or during construction permitting. For renters, energy audits or disclosures are a source of equity, especially for low-income residents of Alameda for whom energy bills are a disproportionate amount of their income. Additionally, requiring disclosures may put pressure on building

[68]Alamedaca.gov. 2021. *Community Housing Resources*. [online] Available at: <https://www.alamedaca.gov/Departments/Community-Development/Community-Housing-Resources>
[69] Irwin, R., 2021. For Information Only, Beneficial Building Electrification Customer Programs Proposal. [online] Alamedamp.com. Available at: <https://www.alamedamp.com/AgendaCenter/ViewFile/Item/7363?fileID=3819>.

owners to make needed upgrades in terms of building efficiency or electrification. There is also potential for the city to begin gathering this information (perhaps an open source database), which may make it easier to know which projects to target and encourage for actual decarbonization in phase two.

The City of Alameda also needs to immediately begin doing planning on whatever financing mechanism they end up deciding is most politically feasible. We recommend beginning work on an inclusive financing program through AMP. This is going to require stakeholder engagement with AMP, the PUC, City Council, the Mayor, as well as businesses, realtors, homeowners, renters, and especially multifamily building owners to make sure that everyone is on board. One of the keys to making inclusive financing work is political buy-in, as well as start up capital. AMP will need money to get the program up and running, but they will also need capital to make the initial electrification and efficiency investments. Getting a good interest rate on that source of money will be key. The money could come from AMP itself or potentially from the City of Alameda, such as through a split utility user tax or as a part of a bonding package.

Additionally, work should begin on determining if a split utility user tax or refundable transfer tax are feasible, particularly politically. Both will require significant outreach, but money from either financing mechanism will be needed to help fund pilot projects for multifamily homes and ideally fund a new energy technical advisor position at the city level.

Phase one will also include a lot of planning on behalf of the city staff for phase two. Drafting proposals and doing the background work necessary for the more aggressive financing mechanisms and point of intervention requirements will take some time, so this process should begin as soon as possible. All of these changes will also require significant stakeholder input and outreach, so getting the ball rolling immediately is critical.

ii. Phase Two

Phase two is when the more difficult and time-consuming pieces of the decarbonization are finalized. We recommend that during phase two, point of sale and point of permit requirements begin to be implemented, as hopefully much of the analysis, background work, and stakeholder engagement and input should have already been completed. As we noted above in our points of intervention section, this is where the City of Alameda should have a finalized list of electrification and efficiency retrofits that are approved for both points of intervention. Alameda should have also determined at this point which of the measures should be mandatory (again determined by stakeholders).

Because of the implementation of requirements at the point of sale and permitting, more robust financing mechanisms should be in place already or starting simultaneously so that the electrification and efficiency requirements are not as onerous for homeowners, renters, or building owners. Phase two is when AMP should begin offering inclusive financing, and ideally the Refundable Electrification Transfer Tax and split utility user tax structure should be rolled out.

With new sources of revenue and the City of Alameda ramping up its electrification and efficiency efforts, these new taxes can be used to hire an Electrification Technical Expert or ombudsman who can direct the city's decarbonization efforts. Additionally, the revenue can be used to fund pilot programs with the Alameda Housing Authority, coordinated by the new staffer.

There are a variety of pilot programs that could be explored with Alameda Housing Authority (or even voluntarily citywide). First, is an education and outreach program on the financial and health benefits of electrification (flyers, demonstrations, cooking demonstrations, audits) to renters, building owners, and building managers. Another option is a program that brings together tenants and building owners to discuss electrification and efficiency retrofits in order

to establish a common understanding and open communication at the start of the process. A burnout-specific education and outreach program to building owners and managers is also an option.

The city could also pilot a larger per-unit rebate for electrification and efficiency in multifamily buildings. Currently, BayREN offers $750 per unit, which many building owners say is too low, but SMUD offers up to $4000 per unit. Piloting a rebate closer to $4000 per unit may be highly effective.[70] To the best of our knowledge, Alameda Housing Authority does not have any sustainability, electrification, or efficiency goals so working with them to develop policies around electrification at the time of burnout as well as efficiency retrofits at the time of unit renovation could prove successful. One unique pilot program that has been suggested would be to switch from renters paying their utility bill to Alameda Housing Authority. Then instead of taking the utility allowance out of the rent calculation, Alameda Housing Authority keeps it to pay for utilities. This could provide an incentive for Alameda Housing Authority to invest in electrification or efficiency measures, because the lower the utility bills become, the more capital they would save (this could apply to any building that accepts Section 8 vouchers). One outstanding concern with this method is the question of how much of the total utility cost the utility allowance would cover. If it ends up not being a significant percentage of the overall cost, this program would likely not pan out. Another pilot program could work to develop some sort of benchmarking program for some of Alameda Housing Authority's larger buildings that could potentially be retooled for commercial or industrial building decarbonization policies that will eventually be developed in Phase 3.

[70] Irwin, R., 2021. *For Information Only, Beneficial Building Electrification Customer Programs Proposal*. [online] Alamedamp.com. Available at: <https://www.alamedamp.com/AgendaCenter/ViewFile/Item/7363?fileID=3819>.

iii. Phase Three

Phase three, which is beyond the scope of this report, is the final phase. It focuses on some of the more difficult parts of decarbonization, either because of politics, cost, or amount of work, or all three. Once the programs and financial incentives have been implemented from phase one and phase two, single family homes will likely be well on their way towards electrification and multifamily buildings will be making good progress. The first objective of phase three is to develop hard requirements for electrification and efficiency retrofits in multifamily buildings. Ideally, the results (and successes) of the pilot programs and financing mechanisms implemented for multifamily building via the Alameda Housing Authority can guide the implementation of actual requirements. Two very important aspects of requirements for multifamily housing are tenant protections and synthesis with other rebates. Building owners should be prevented from raising rents for a certain period of time after performing electrification and efficiency upgrades. This is especially the case in situations where building owners pay the utility bill, because they are essentially benefiting twice from their work through utility bill savings and increased rent. Additionally, many building owners have raised the point that while rebates might be helpful, they often have different requirements in order to benefit from them. It could be very useful for the City of Alameda and AMP to streamline the rebate requirements by tying them to either state or federal requirements rather than creating their own.

At this point, the city should begin work on implementing policies to decarbonize commercial and industrial buildings. It is also likely a new cost-effectiveness analysis will be needed. As electrification and efficiency retrofits begin to take hold across the country, prices will continue to drop, potentially making more measures cost-effective for the City of Alameda. Residents should be aware of these developments and the city should consider updating its requirements. Additionally, the remaining gas users will most likely be facing higher fees due to utility stranding and many projections that say natural gas will increase in price.

Finally, in phase three we recommend creating burnout requirements, specifically for stoves and dryers. The reason this requirement falls into phase three is that despite the fact that gas stoves and dryers account for approximately 15 percent of a building's emissions,[71] these appliances, particularly gas stoves, have become the third rail of building decarbonization. Waiting until many of the other successes of the building decarbonization plan in Alameda have been demonstrated might help ease the political fight. Additionally, stoves and dryers have a much higher profile because they are something many households see and use every day. We expect that as prices continue to come down and more people buy these appliances for their homes there will be a quicker uptake. Additionally, waiting until the end of the process allows for much of the groundwork to be laid in terms of panels and outlets in the kitchen and laundry areas. This will make the transition much smoother for people. Therefore waiting until the final stage to include specific requirements, particularly around stoves, would not have a huge impact on emissions, and because of natural dissemination of information through word of mouth we expect there to be a large increase in implementation without the need for mandates.

A completely decarbonized building sector in Alameda is likely still many years away. However, Alameda already has all of the tools necessary to work towards that goal. With hard work and patience, achieving the goal of reaching 100 percent electrified buildings in Alameda is completely possible.

d. Recommended Future Work

All of these phases are intended to lay out a long term and broad timeline for decarbonizing existing buildings in the City of Alameda. However, within Phase One and Phase Two of our timeline there are some pressing next steps that need to be taken that were either outside the scope of our report or were beyond our capacity.

[71] Irwin, R., 2021. *For Information Only, Beneficial Building Electrification Customer Programs Proposal*. [online] Alamedamp.com. Available at: <https://www.alamedamp.com/AgendaCenter/ViewFile/Item/7363?fileID=3819>.

1. Multifamily Housing
    a. Work must immediately be started on an Alameda specific cost-effectiveness and carbon emission reduction analysis for multifamily housing.
    b. A partnership should be formed with leaders at Alameda Housing Authority to begin feasibility discussions related to pilot projects.
2. Financing
    a. An analysis should be done to determine the feasibility and start-up capital required for AMP to implement an Inclusive Financing program.
    b. A determination should be made if 2022 bonding money can be used as start-up capital or to potentially create a city decarbonization fund.
    c. Finalize levels of a potential transfer tax, split utility user tax, and split permitting fee system.
3. Education and Outreach
    a. The City of Alameda should coordinate with AMP to determine if the positions AMP is adding would cover the responsibilities of an Energy Technical Advisor outlined above or if an additional city position is needed.
    b. Alameda should work to finalize a draft of a plan and begin stakeholder outreach with both residents, businesses, and other relevant stakeholders (such as contractors and realtors) to determine how they would react to the recommendations in this report and what they would like to see in an existing building decarbonization reach code.

XI. Appendices

Appendix I. City of Alameda transfer tax data (July 2017 - April 2019)

Month and Year	Number of Transfers
July 2017	185
August 2017	194
September 2017	179
October 2017	201
November 2017	215
December 2017	217
January 2018	132
February 2018	127
March 2018	179
April 2018	150
May 2018	173
June 2018	203
September 2018	140
October 2018	176
November 2018	134
December 2018	170
Jan 2019	132
Feb 2019	115
March 2019	134
April 2019	149

May 2019	179
June 2019	162
Monthly Average Transfers	**165.7**
Estimated Yearly Transfers	**1988.7**

Appendix II. Building use codes and descriptions included in housing analysis

	Use Code	Common Name
Single	1100	single-family residential homes used as such
	1140	single-family residential home, R&T 402.1
	1190	single-family residential (tract) common area or use
	1200	single-family res home with non-economic 2nd unit
	1300	single-family Res home with slight commercial/ind
	1400	single-family Res - Duet Style
	1500	Townhouse - Planned Development
	1540	Townhouse - Planned Development, R&T 402.1
	1590	Townhouse - Planned Development, Common Area or use
	1690	SFR Detached Site Condominium , Common Area or use
	1800	SFR - Planned Development Tract with Common Area
	1840	SFR - Planned Development Tract, R&T 402.1
	1890	SFR - Planned Development Tract, Common Area or use
	2200	Double, or duplex type - two units
	2300	Triple: double or duplex with single-family home
	7100	Two, three or four single-family homes
Multi	1700	single-family res home converted to boarding house
	2100	Two, three or four single-family homes
	2400	Four living units; e.g. fourplex or triplex w/SFR

	2500	2 units, lesser quality than 2200 or unknown legal
	2600	3 units, lesser quality than 2300 or unknown legal
	2700	4 units, lesser quality than 2400 or unknown legal
	2800	Res property of 2,3 or 4 units with rooming house
	3200	Store on 1st floor, with offices, apts/lofts 2nd/3
	3990	Condominium-commercial retail, common area or use
	7200	Residential property converted to 5 or more units
	7300	Condominium - single residential living unit
	7390	Condominium Common Area or use
	7500	Restricted residential income property
	7700	Multiple residential buildings of 5 or more units.
	7800	Residential high-rise (7 or more stories)

Appendix III. City of Alameda residential housing results by building use code

	UseCode	No	BuildingAr	NoBedrooms	NoUnits	Median_YrBuilt
Single	1100	9,913	1,732.36	3.05	1	1927
	1140	47	1,571.47	3.02	0.85	2006
	1190	61	-	-	-	-
	1200	45	2,107.89	3.82	1.84	1902
	1300	20	1,900.25	2.35	1.05	1909
	1400	462	1,715.22	2.72	1	1986
	1500	1,529	1,576.47	2.8	0.99	1971
	1540	19	1,395.37	3	1	2003
	1590	53	42.70	-	-	1970
	1690	1	8,643.00	7	2	2009
	1800	2,084	2,012.57	3.12	0.96	1987
	1840	17	1,511.47	3	1	2008
	1890	293	9.06	0.01	0	1988
	2200	406	2,143.78	3.9	2.02	1939
	2300	135	3,039.96	5.45	2.94	1933
	7100	3	5,138.67	10.33	6	-

	Total	**15,088**	**1,732.41**	**2.99**	**1.01**	**-**
Multi	1700	3	4,665.00	10.67	1.33	1908
	2100	270	2,290.79	3.99	2.02	1915.5
	2400	202	3,691.64	6.18	3.97	1947
	2500	551	2,178.01	3.13	1.96	1900
	2600	262	2,714.67	4.18	2.96	1900
	2700	204	3,135.45	4.34	3.92	1900
	2800	12	3,778.58	7.58	3.08	1895
	3200	140	6,449.24	2.31	2.82	1910
	3990	11	9,600.09	-	4.18	1999
	7200	111	4,482.74	6.07	6.03	1908
	7300	43	1,612.84	2.42	40.26	1971
	7390	135	1,802.79	3.3	2.56	1988
	7500	1	35,462.00	62	61	1971
	7700	436	14,362.13	24.32	16.8	1962
	7800	1	77,660.00	147	84	1966
	Total	2,382	5,108.45	7.77	6.17	-

Appendix IV. Total greenhouse gas reductions for individual electrification and efficiency measures

Cells highlighted in the "Total GHG Savings in Tons" column were determined to be cost effective based on results from the Frontier Energy report using 2022 TDV modeling parameters.

Measure	Vintage	GHG Savings (lb CO2e)	Number of Single Family Buildings	Total GHG Savings in Tons
R-49 Attic Insulation	Pre-1978	359	10,421	**1871**
	1978-1991	184	2,654	**244**
	1992-2010	65	1,426	**46**
Reduced Infiltration	Pre-1978	143	10,421	**745**
	1978-1991	90	2,654	**119**
	1992-2010	57	1,426	**41**
Duct Sealing	Pre-1978	315	10,421	**1641**
	1978-1991	175	2,654	**232**

	1992-2010	48	1,426	**34**
New Ducts	Pre-1978	567	10,421	**2954**
	1978-1991	392	2,654	**520**
	1992-2010	164	1,426	**117**
R-13 Wall Insulation	Pre-1978	458	10,421	**2386**
	1978-1991	0	2,654	**0**
	1992-2010	0	1,426	**0**
Windows	Pre-1978	309	10,421	**1610**
	1978-1991	276	2,654	**366**
	1992-2010	0	1,426	**0**
LED lamp vs CFL	Pre-1978	0	10,421	**0**
	1978-1991	0	2,654	**0**
	1992-2010	0	1,426	**0**
Exterior Photosensor	Pre-1978	0	10,421	**0**
	1978-1991	0	2,654	**0**
	1992-2010	0	1,426	**0**
R49 Attic & Air Sealing Package	Pre-1978	511	10,421	**2663**
	1978-1991	276	2,654	**366**
	1992-2010	123	1,426	**88**
R49 Attic & Duct Sealing Package	Pre-1978	651	10,421	**3392**
	1978-1991	346	2,654	**459**
	1992-2010	113	1,426	**81**
R49 Attic, Air Sealing & Duct Sealing Package	Pre-1978	788	10,421	**4106**
	1978-1991	430	2,654	**571**
	1992-2010	169	1,426	**120**
R49 Attic, Air Sealing & New Ducts Package	Pre-1978	1029	10,421	**5362**
	1978-1991	632	2,654	**839**
	1992-2010	279	1,426	**199**
Advanced Envelope Package	Pre-1978	1451	10,421	**7560**
	1978-1991	0	2,654	**0**
	1992-2010	0	1,426	**0**
Water Heating Package	Pre-1978	0	10,421	**0**
	1978-1991	0	2,654	**0**
	1992-2010	0	1,426	**0**

Heat Pump at HVAC Replacement	Pre-1978	1527	10,421	**7956**
	1978-1991	1030	2,654	**1367**
	1992-2010	793	1,426	**565**
High-Effic. Heat Pump at HVAC Replacement	Pre-1978	1624	10,421	**8462**
	1978-1991	1104	2,654	**1465**
	1992-2010	850	1,426	**606**
Heat Pump at HVAC Replacement + 2.17 kWdc PV	Pre-1978	1753	10,421	**9134**
	1978-1991	1256	2,654	**1667**
	1992-2010	1018	1,426	**726**
HPWH at Water Heater Replacement	Pre-1978	1378	10,421	**7180**
	1978-1991	1386	2,654	**1839**
	1992-2010	6211	1,426	**4428**
NEEA Tier 3 HPWH at Replacement	Pre-1978	1488	10,421	**7753**
	1978-1991	1500	2,654	**1991**
	1992-2010	5883	1,426	**4195**
HPWH at Water Heater Replacement + 2.17 kWdc PV	Pre-1978	1604	10,421	**8358**
	1978-1991	1611	2,654	**2138**
	1992-2010	1612	1,426	**1149**

Appendix V. Individual and total cost of individual electrification and efficiency measures

Cells highlighted in the "Total GHG Cost of Measure" column were determined to be cost effective based on results from the Frontier Energy report using 2022 TDV modeling parameters.

Measure	Vintage	Measure Cost	Number of Single Family Buildings	Total Cost of Measure
R-49 Attic Insulation	Pre-1978	3,332	10,421	**34,722,772**
	1978-1991	2,874	2,654	**7,627,596**
	1992-2010	2,333	1,426	**3,326,858**

Reduced Infiltration	Pre-1978	1,474	10,421	**15,360,554**
	1978-1991	1,474	2,654	**3,911,996**
	1992-2010	1,474	1,426	**2,101,924**
Duct Sealing	Pre-1978	683	10,421	**7,117,543**
	1978-1991	683	2,654	**1,812,682**
	1992-2010	423	1,426	**603,198**
New Ducts	Pre-1978	3,986	10,421	**41,538,106**
	1978-1991	3,986	2,654	**10,578,844**
	1992-2010	3,986	1,426	**5,684,036**
R-13 Wall Insulation	Pre-1978	3,360	10,421	**35,014,560**
	1978-1991	0	2,654	**0**
	1992-2010	0	1,426	**0**
Windows	Pre-1978	9,810	10,421	**102,230,010**
	1978-1991	9,810	2,654	**26,035,740**
	1992-2010	0	1,426	**0**
LED lamp vs CFL	Pre-1978	2	10,421	**23,551**
	1978-1991	2	2,654	**5,998**
	1992-2010	2	1,426	**3,223**
Exterior Photosensor	Pre-1978	43	10,421	**443,726**
	1978-1991	43	2,654	**113,007**
	1992-2010	43	1,426	**60,719**
R49 Attic & Air Sealing Package	Pre-1978	4,806	10,421	**50,083,326**
	1978-1991	4,348	2,654	**11,539,592**
	1992-2010	3,807	1,426	**5,428,782**
R49 Attic & Duct Sealing Package	Pre-1978	4,015	10,421	**41,840,315**
	1978-1991	3,557	2,654	**9,440,278**
	1992-2010	2,756	1,426	**3,930,056**
R49 Attic, Air Sealing & Duct Sealing Package	Pre-1978	5,489	10,421	**57,200,869**
	1978-1991	5,031	2,654	**13,352,274**
	1992-2010	4,230	1,426	**6,031,980**
R49 Attic, Air Sealing & New Ducts Package	Pre-1978	8,792	10,421	**91,621,432**
	1978-1991	8,334	2,654	**22,118,436**
	1992-2010	7,793	1,426	**11,112,818**
Advanced	Pre-1978	18,659	10,421	**194,445,439**

Envelope Package	1978-1991	0	2,654	**0**
	1992-2010	0	1,426	**0**
Water Heating Package	Pre-1978	208	10,421	**2,167,568**
	1978-1991	208	2,654	**552,032**
	1992-2010	208	1,426	**296,608**
Heat Pump at HVAC Replacement	Pre-1978	1,555	10,421	**16,204,655**
	1978-1991	1,555	2,654	**4,126,970**
	1992-2010	1,555	1,426	**2,217,430**
High-Effic. Heat Pump at HVAC Replacement	Pre-1978	4,024	10,421	**41,934,104**
	1978-1991	4,024	2,654	**10,679,696**
	1992-2010	4,024	1,426	**5,738,224**
Heat Pump at HVAC Replacement + 2.17 kWdc PV	Pre-1978	9,643	10,421	**100,489,703**
	1978-1991	9,643	2,654	**25,592,522**
	1992-2010	9,643	1,426	**13,750,918**
HPWH at Water Heater Replacement	Pre-1978	2,594	10,421	**27,032,074**
	1978-1991	2,594	2,654	**6,884,476**
	1992-2010	2,594	1,426	**3,699,044**
NEEA Tier 3 HPWH at Replacement	Pre-1978	2,775	10,421	**28,918,275**
	1978-1991	2,775	2,654	**7,364,850**
	1992-2010	2,775	1,426	**3,957,150**
HPWH at Water Heater Replacement + 2.17 kWdc PV	Pre-1978	10,682	10,421	**111,317,122**
	1978-1991	10,682	2,654	**28,350,028**
	1992-2010	10,682	1,426	**15,232,532**

XII. Works Cited

1. Alameda Climate Action and Resiliency Plan (CARP). 2019. Alameda: City of Alameda. Available at: <https://www.alamedaca.gov/files/sharedassets/public/public-works/climate-action-page/new-folder/final-carp-9-2019/alameda_carp_final_091119noappendices.pdf` >

2. Alamedaca.gov. 2021. Community Housing Resources. [online] Available at: <https://www.alamedaca.gov/Departments/Community-Development/Community-Housing-Resources>

3. Alamedaca.gov. 2021. City of Alameda Master Fee Schedule. [online] Available at: <https://www.alamedaca.gov/files/assets/public/2018-19-master-fee-schedule.pdf>

4. Alamedaca.gov. 2021. When is a permit needed?. [online] Available at: <https://www.alamedaca.gov/Departments/Planning-Building-and-Transportation/Permit-Center/When-Is-A-Permit-Needed>

5. Alamedamp.com. 2021. Rebates & Incentives | Alameda Municipal Power, CA. [online] Available at: <https://www.alamedamp.com/164/Rebates-Incentives>

6. BayREN.org. 2021. About BayREN. [online] Available at: <https://www.bayren.org/about-bayren> .

7. BayREN.org. 2021. BayREN Electrification. [online] Available at: <https://www.bayren.org/electrification>.

8. BayREN.org. 2021. BayREN Homeowners. [online] Available at: <https://www.bayren.org/homeowners>.

9. BayREN.org. 2021. BayREN Multifamily. [online] Available at: <https://www.bayren.org/multifamily>.

10. BayREN.org. 2021. BayREN Renters. [online] Available at: <https://www.bayren.org/renters>.

11. BayREN.org. 2021. Home Energy Scores. [online] Available at: <https://www.bayren.org/hes>.

12. Cityofberkeley.info. 2021. [online] Available at: <https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Draft_Berkeley_Existing_Bldg_Electrification_Strategy_20210415.pdf> .

13. Cityofberkeley.info. 2021. City of Berkeley Natural Gas Prohibition & Reach Code for Electrification. [online] Available at: <https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Berkeley%20Energy%20Reach%20Code%20for%20Electrification%20and%20Natural%20Gas%20Prohibition%209-27-19.pdf>.

14. Cityofberkeley.info. 2021. Real Property: Transfer Tax Seismic Refunds - City of Berkeley, CA. [online] Available at:

<https://www.cityofberkeley.info/Finance/Home/Real_Property__Transfer_Tax_Seismic_Refunds.aspx>.

15. Cityofvallejo.net. 2021. Utility Users Tax (UUT) Information. [online] Available at: <https://www.cityofvallejo.net/city_hall/departments___divisions/finance/utility_users_tax___u_u_t__information>

16. CommunityPowerMN.org . 2021. Inclusive Financing FAQ. [online] Available at: <https://www.communitypowermn.org/inclusive_financing_faq>.

17. Decision Tool for Utility Managers. 2016. The Energy Efficiency Institute, Inc.: Vermont. Available at: <https://www.roanokeelectric.com/wp-content/uploads/Decision-Tool-for-Utility-Managers-v14.pdf>.

18. DeVries, A., 2021. The Alameda County Real Estate Report. [online] Rereport.com. Available at: <https://rereport.com/alc/index.html>.

19. Eaton, E., 2014. Residential Lighting Controls Market Characterization. [ebook] Boston: Consortium for Energy Efficiency. Available at: <http://ttps://library.cee1.org/system/files/library/11458/CEE_LightingMarketCharacterization.pdf>.

20. Energy.gov 2021. Find Assessors with our Tool [online] Available at: <https://betterbuildingssolutioncenter.energy.gov/home-energy-score/home-energy-score-partner-map>.

21. Energy.gov. 2021. Property Assessed Clean Energy Programs. [online] Available at: <https://www.energy.gov/eere/slsc/property-assessed-clean-energy-programs> .

22. Energy.gov. 2021. Property Assessed Clean Energy Programs. [online] Available at: <https://www.energy.gov/eere/slsc/property-assessed-clean-energy-programs>.

23. Frontier Energy, Inc., Misti Bruceri and Associates LLC, 2019. 2019 Cost-Effectiveness Study: 2020 Analysis of Low-Rise Residential Addendum – City of Alameda Analysis. Alameda: Pacific Gas and Electric Company.

24. Gaffney, K., Goldberg, M., Tanimoto, P. and Johnson, A., 2021. I Know What You Lit Last Summer: Results from California's Residential Lighting Metering Study. [online] Aceee.org. Available at: <https://www.aceee.org/files/proceedings/2010/data/papers/2225.pdf>.

25. Homeadvisor.org. 2021. How Much Does It Cost To Upgrade Or Replace An Electrical Panel? [online] Available at: <https://www.homeadvisor.com/cost/electrical/upgrade-an-electrical-panel/#:~:text=Average%20Cost%20to%20Upgrade%20an,%242%2C000%20for%20their%20project%20labor>.

26. Irwin, R., 2021. For Information Only, Beneficial Building Electrification Customer Programs Proposal. [online] Alamedamp.com. Available at: <https://www.alamedamp.com/AgendaCenter/ViewFile/Item/7363?fileID=3819>.

27. OhmConnect.com 2021 OhmConnect. [online] Available at <https://www.ohmconnect.com/>.

28. Pge.com. 2021. The ABCs of OBF: Learning How PG&E's On-Bill Financing Works | PG&E. [online] Available at: <https://www.pge.com/en/mybusiness/save/smbblog/article/the_abcs_of_obf_learning_how_pges_onbill_financing_works.page?redirect=yes>.

29. Piedmont.ca.gov. 2021. City Council of Piedmont, Agenda, February 1, 2021. [online] Available at: <https://piedmont.ca.gov/common/pages/DisplayFile.aspx?itemId=17376920>.

30. Piedmont.ca.gov. 2021. Reach Codes. [online] Available at: <https://piedmont.ca.gov/government/city_news___notifications/reach_codes>.

31. Prioritizing California's Affordable Housing in the Transition Towards Equitable Building Decarbonization. 2021. California Housing Partnership. Available at: <https://1p08d91kd0c03rlxhmhtydpr-wpengine.netdna-ssl.com/wp-content/uploads/2021/04/BuildingDecarbonizationSummitAHReport2021.pdf>.

32. Rising Sun Center for Opportunity. 2021. Green House Call - Rising Sun Center for Opportunity. [online] Available at: <https://risingsunopp.org/programs/ghc/>

33. Santamonica.gov. 2021. City of Santa Monica | Official Website. [online] Available at: <https://www.santamonica.gov/blog/santa-monica-receives-the-2020-national-leadership-in-sustainability-award-from-the-international-code-council> .

34. Smgov.net. 2021. Energy Reach Code - Community Development Department - City of Santa Monica. [online] Available at: <https://www.smgov.net/Departments/PCD/Permits/Codes-Standards-Requirements/Energy-Reach-Code/>.

35. Smud.org. 2021. SMUD Energy Store. [online] Available at: <https://smudenergystore.com/>.

36. Smud.org. 2021. In Our Community: Workshops. [online] Available at: <https://www.smud.org/en/In-Our-Community/Workshops-and-education-resources/Residential >.

37. Smud.org. 2021. SMUD Rebates and Savings Tips. [online] Available at: <https://www.smud.org/en/Rebates-and-Savings-Tips/Rebates-for-My-Home>

38. Tariffed On-Bill Financing Feasibility. 2019. CADMUS. Available at: <http://energytransition.umn.edu/wp-content/uploads/2019/08/Minnesota-TOB-Financing-FINAL_AH-1.pdf>.

39. Uutinfo.org. 2021. City of Alameda - UUT. [online] Available at: <http://www.uutinfo.org/uutinfo_city_info/alameda/uutinfo_alameda.htm>.