Rincon Consultants, Inc.
449 15th Street, Suite 303
Oakland, California 94612
510-834-4455

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Project No: 23-14014

Andrea Chow
Sustainability Analyst
City of San Mateo
City Manager's Office
330 West 20th Ave.
San Mateo, California, 94403
Via email: achow@cityofsanmateo.org

Subject: Building Inventory and Market Segmentation Memorandum (Task 1)
Building for the Future – City of San Mateo Sustainable Buildings Strategy *(Version 2)*

**Version 2 applies updated PCE Incentives (-$1,000 from previous memo) as of 08.24.2023 to electrification marginal costs, and cost savings listed in this memo*

Dear Ms. Chow:

To develop an equitable, implementable, and effective Sustainable Building Strategy (SBS), the City of San Mateo (City) first needs to understand the existing building stock and energy usage and develop estimates for the various costs associated with building electrification.[1] Part of this analysis includes investigating the up-front appliance costs[2] for electrification, the cost of other upgrades that may be required to convert energy usage in buildings from gas to electricity, the financial incentives currently available for this work, as well as existing conditions of the building stock within the City and other practical opportunities or barriers to electrification of existing buildings. To answer questions about up-front costs, available incentives, existing conditions, and other opportunities and barriers, in collaboration with the City, Rincon completed a meta-analysis of existing cost studies and reviewed several electrification project case studies which have been completed within the City and County of San Mateo. This memo summarizes the information gathered from these reviews and case studies.

This memo is intended to be used in developing educational materials for the community and informing future policy development. Data in this report was summarized from existing sources, some of which are not specific to the City of San Mateo. However, the findings are of sufficient scale and accuracy to help guide this process but not intended as an accurate interpretation of the final cost of electrification for any one building in the City. This memo includes the following pieces of analysis, which is organized according to San Mateo building stock categories: Single Family Homes and Low-Rise Multifamily, and **Note that IRA incentives take the form of tax credits, while other rebates can be applied upfront by*

[1] Building electrification refers to the replacement of gas-fired equipment or appliances in a building with electric equipment or appliances.
[2] Up-front costs include the cost to buy a new appliance and have it installed by qualified personnel. Up-front costs include additional costs that may come with other upgrades needed to make installation of the new appliance possible (e.g., installation of new wiring to install an electric stove, where there was previously only a gas hookup).

the building owner or contractor after completing program documentation requirements. Please refer to Table 6 for a full summary of rebates and incentives by funder.

High-Rise Multifamily and Nonresidential Building.

- Part 1: Residential Building Segmentation Analysis
  - Building Stock
  - Building Vintage
  - Appliance and Fuel Source Analysis
- Part 2: High-Rise Multifamily and Commercial Building Segmentation Analysis
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  - Building Vintage
  - Appliance and Fuel Source Analysis
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    - Gas-for-Gas Scenario
    - Gas-to-Electric Scenario
    - Gas-to-Electric Scenario (marginal costs)
    - Costs to Electrify Scenario (marginal costs- incentives)
    - Commercial Building Cost Analysis
  - Description of Building Electrification Costs Overview
    - Single Family Electrification Cost Discussion
    - Baseline Scenario: Gas to Gas Appliance Replacement
    - Electrification Scenario: Gas to Electric
    - Electrification Incentives Overview
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  - High-Rise Multifamily and Nonresidential Buildings Electrification Cost Discussion
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    - Current Incentives
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This memorandum's costs and building energy usage will be updated to reflect the current data as additional information becomes more available through project development. Once finalized, this memo will also serve as a technical appendix to the final Sustainable Buildings Strategy.

Note that an on-bill cost analysis is currently being completed by Peninsula Clean Energy (PCE) and will be incorporated into future analyses and policy development when it is made available to the Project Team.

PART 1: RESIDENTIAL BUILDING SEGMENTATION ANALYSIS

Single Family Homes and Low-Rise Multifamily Building Segmentation Analysis

For this analysis, single family homes and low rise (3 stories and under) multifamily are discussed together. This is because they generally utilize similar equipment and share similar costs for electrification. These building types include single family, duplex, townhouse, rowhouse, and parcels with multiple single unit/duplex buildings. Commercial and high rise (over 3 stories) buildings are discussed in a later section.

Significance of Building Vintage

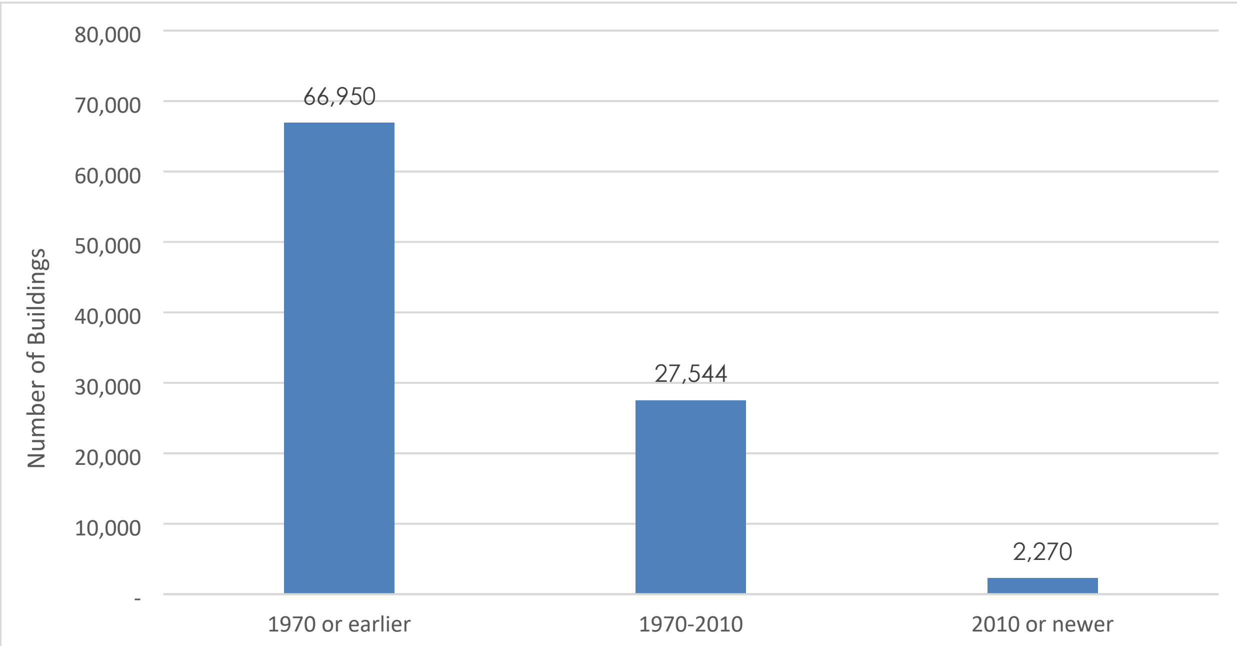
Building vintage[3] can be used to provide a sense of the technologies employed in a particular building. While vintage does not tell us if updates have been made, it does provide some idea of potential hurdles that might be faced when completing electrification work. Based on anecdotal evidence, buildings constructed after 1970 are more likely to have electric panels of 100 amps or more instead of lower amp panels or fuse boxes which may require upgrades and may impede electrification work. A significant number (70%) of San Mateo's single-family homes were built before 1970 and could potentially need panel upgrades or other electrical work prior to full electrification as shown in Figure 1. However, progress on and availability of circuit sharing technologies and retrofit ready (120 volt) heat pump products continues to lower the number of buildings which require panel upgrades. Adding an electric vehicle (EV) also increases the chance of needing a panel or service upgrade which should be considered when looking at whole home electrification.

Building Segmentation Analysis

According to the parcel data obtained from San Mateo County, there are approximately 96,800 single family residential buildings within the City of San Mateo. The years in which they were built (building vintage) are included in Figure 1.

[3] Building vintage refers to the age ('vintage') of the building, based on the approximate date it was built.

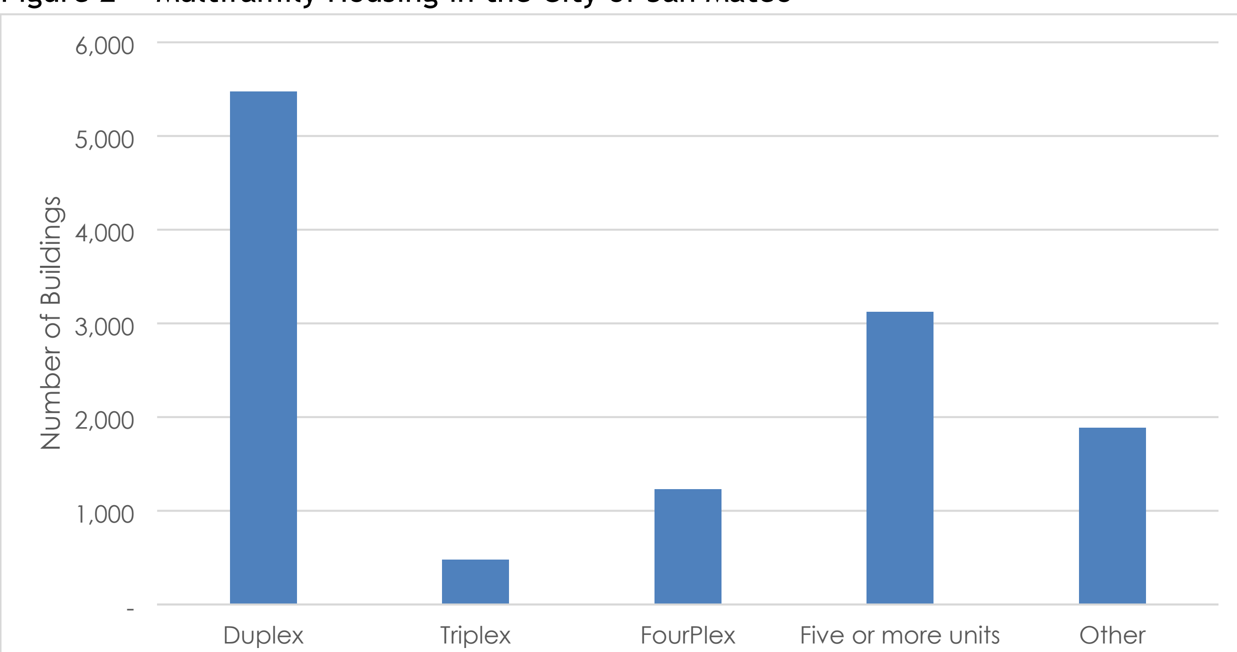
Figure 1 Number of Single-Family Residential Buildings Built by Year in the City of San Mateo



Data Source: San Mateo County Parcel Data

In addition, there are approximately 12,100 multifamily buildings. The breakdown of buildings by type is included in Figure 2. No building vintage data for multifamily buildings was available at the time of drafting this report.

Figure 2 Multifamily Housing in the City of San Mateo



Data Source: San Mateo County Parcel Data

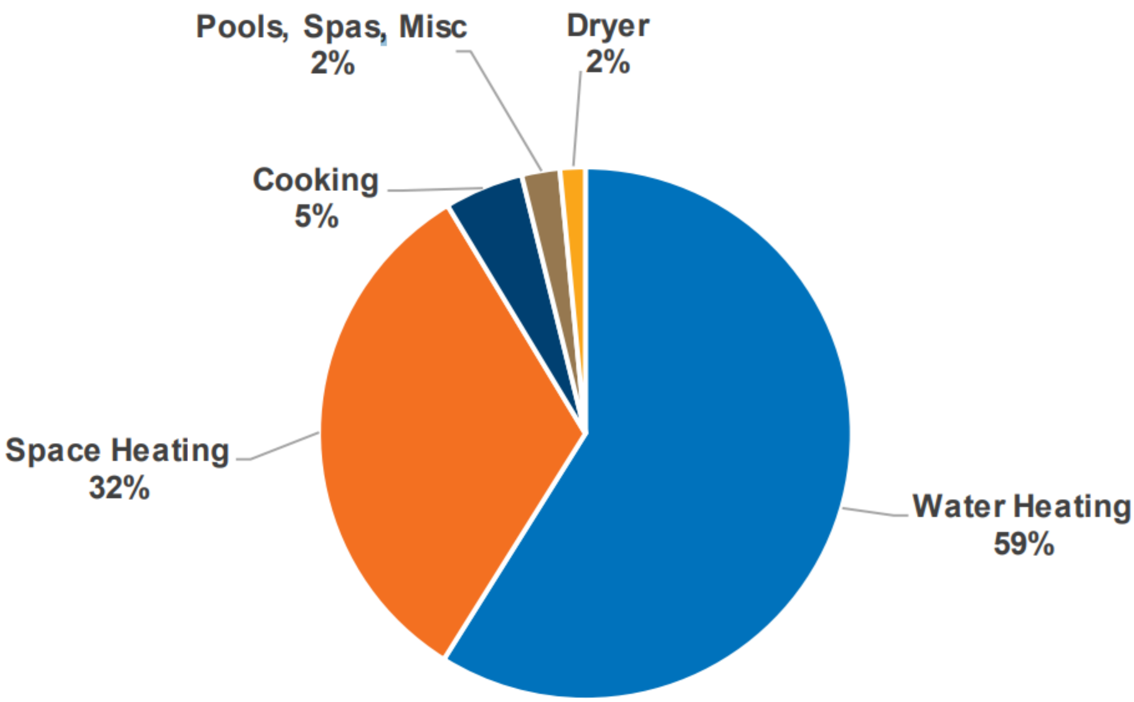
Appliance and Fuel Source Analysis

To better understand where natural gas is being used in San Mateo's buildings, an appliance fuel source analysis was completed using existing data provided by PCE. The data provided by PCE leveraged the Residential Appliance Saturation Survey (RASS) for Climate Zone 3 for most appliance types with the exception of heating fuel source.[4] Heating fuel source data was based on the American Community Survey which utilizes specific San Mateo County Data.[5] Heating system types were pulled from the RASS Study but normalized using American Community Survey (ACS) fuel source data which is more specific to San Mateo County. This normalization process weighted fuel types more heavily towards the ACS results for fuel types but utilizes the relevant equipment types from the RASS. This data is not specific to the City of San Mateo but provides a good understanding of the fuel and appliance types common in the region. Based on this analysis, most gas consumption in residential buildings comes from space and water heating, as shown in Figure 3.

[4] The California Residential Appliance Saturation Study (RASS) is a comprehensive look at residential energy use. The California Energy Commission (CEC) manages the study, which is based on the California Home Energy Survey. The survey collects information from residents about appliances, heating and cooling equipment, electric vehicles, and energy.

[5] The American Community Survey (ACS) detailed population and housing information and is intended to helps local officials, community leaders, and businesses understand the changes taking place in their communities.

Figure 3 2019 California Residential End Use Survey Gas Consumption



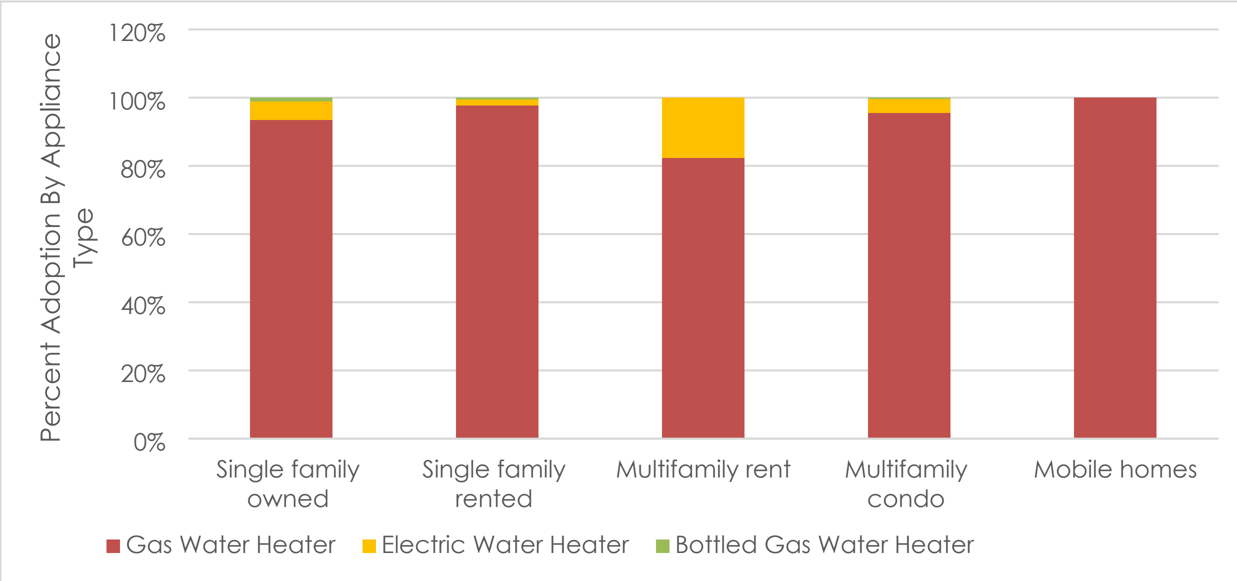
Data Source: California End Use Survey (CEUS)

Water Heating Fuel Types

In San Mateo County the vast majority of water heaters run on natural gas (though most gas water heaters also require electricity to operate) as shown in Figure 4.[6] Multifamily buildings have the largest percentage of electric water heating. A small percentage of buildings within the county also run on bottled gas (propane), but these buildings are likely to be in the unincorporated areas away from natural gas infrastructure.

[6] https://www.schnellerair.com/blog/shower-during-power-outage/

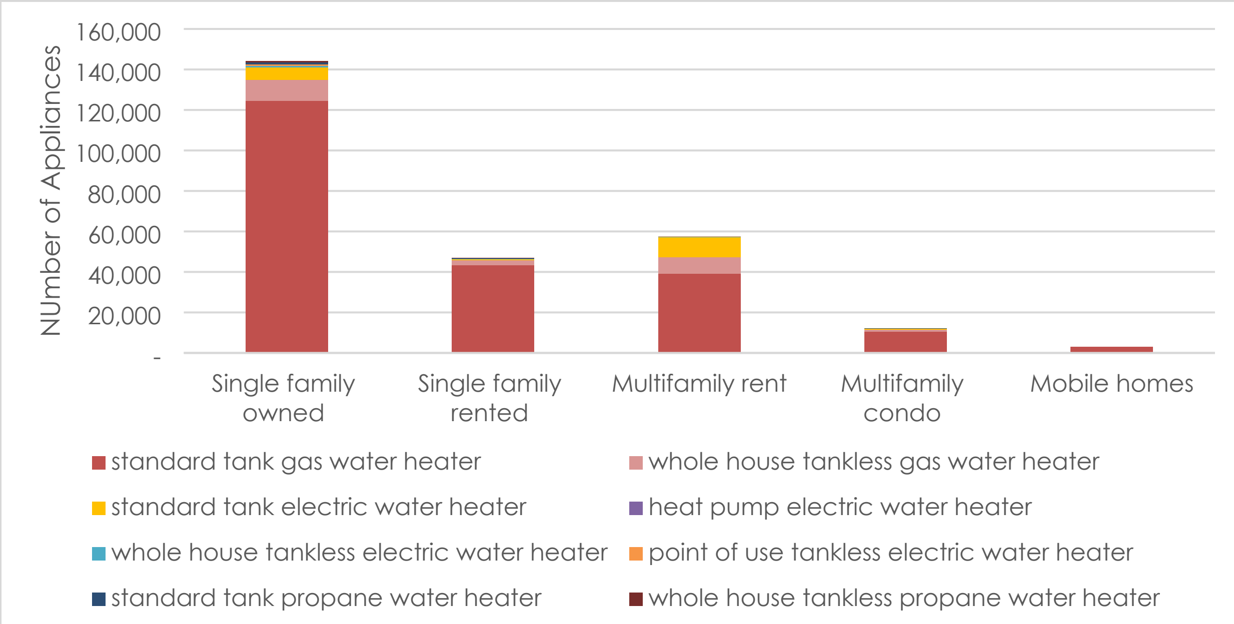
Figure 4 Water Heater Fuel Types by Building Type in San Mateo County



Data Source: Residential Appliance Saturation Survey (RASS)

As shown in Figure 5, most of the water heaters in San Mateo County are standard gas fired water heaters, especially in single family homes. Whole house tankless gas water heaters are the next most common followed by standard electric resistance water heaters, tankless electric varieties and heat pumps. Different types of water heaters will have different space and cost impacts on operations. This detail will likely be building specific. However, standard gas tank water heaters are most common and can be replaced by heat pump tank water heaters in most scenarios.

Figure 5: Water Heater System Counts by Building Type in San Mateo County

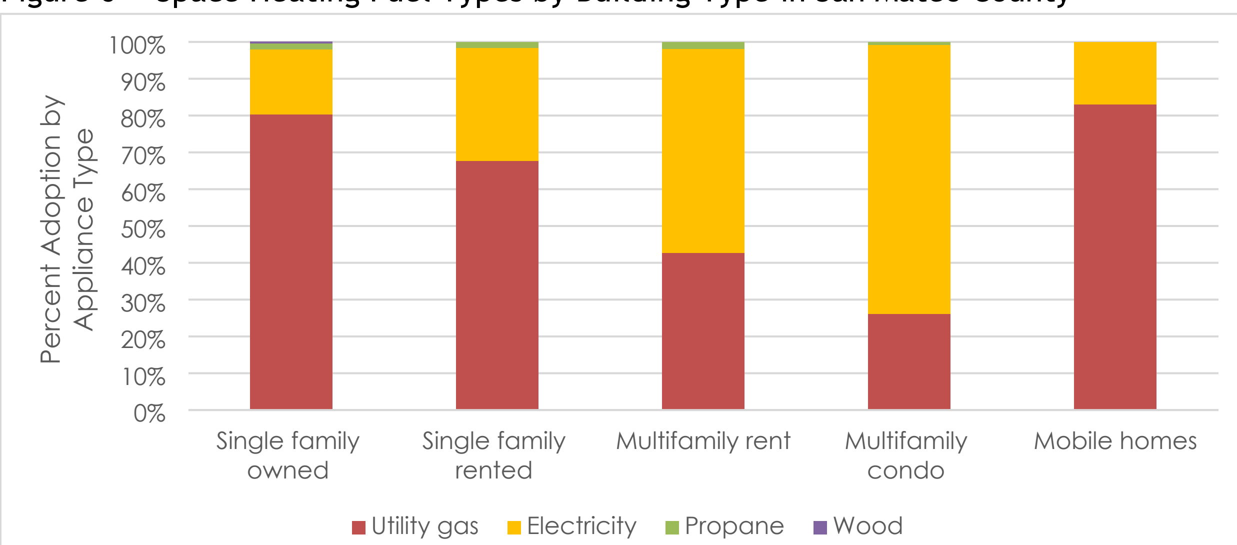


Data Source: Residential Appliance Saturation Survey (RASS)

Furnace Types

Space heating is the second largest gas consumption device in residential buildings. Space heating in San Mateo County sees a much broader use of electric appliances especially in multifamily rentals and multifamily condos, as shown in Figure 6. Single family owned and rented buildings still use gas most commonly. Some wood and propane use is seen within the County, but is most likely in the unincorporated regions.

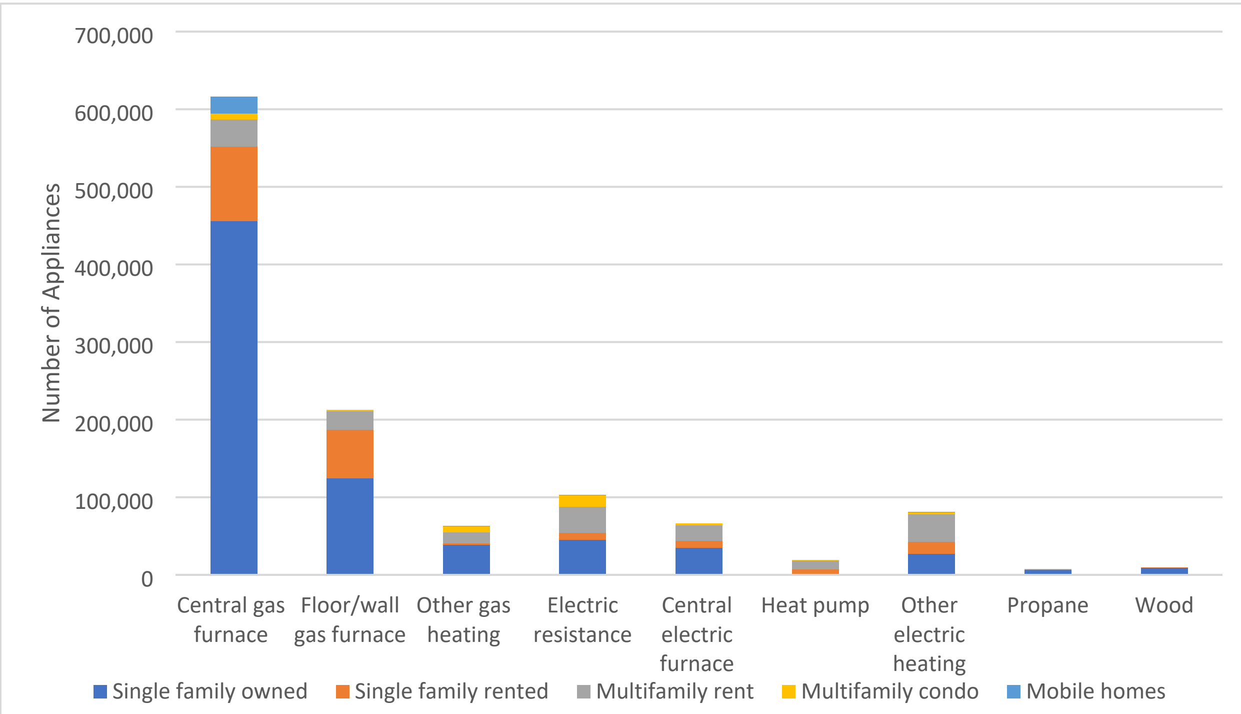
Figure 6 Space Heating Fuel Types by Building Type in San Mateo County



Data Source: Residential Appliance Saturation Survey (RASS)

As shown in Figure 7, central gas furnaces are the most common space heating system type in the County, driven primarily by single family buildings. Currently, most electric space heating is electric resistance in both single and multifamily buildings. Different types of furnaces will have different space and cost impacts on operations. This detail will likely be building specific. However, central gas furnaces are most common and can be replaced by central air source heat pumps in most scenarios. These heat pumps also provide air conditioning.

Figure 7 Space Heating System Counts by Building Type in San Mateo County

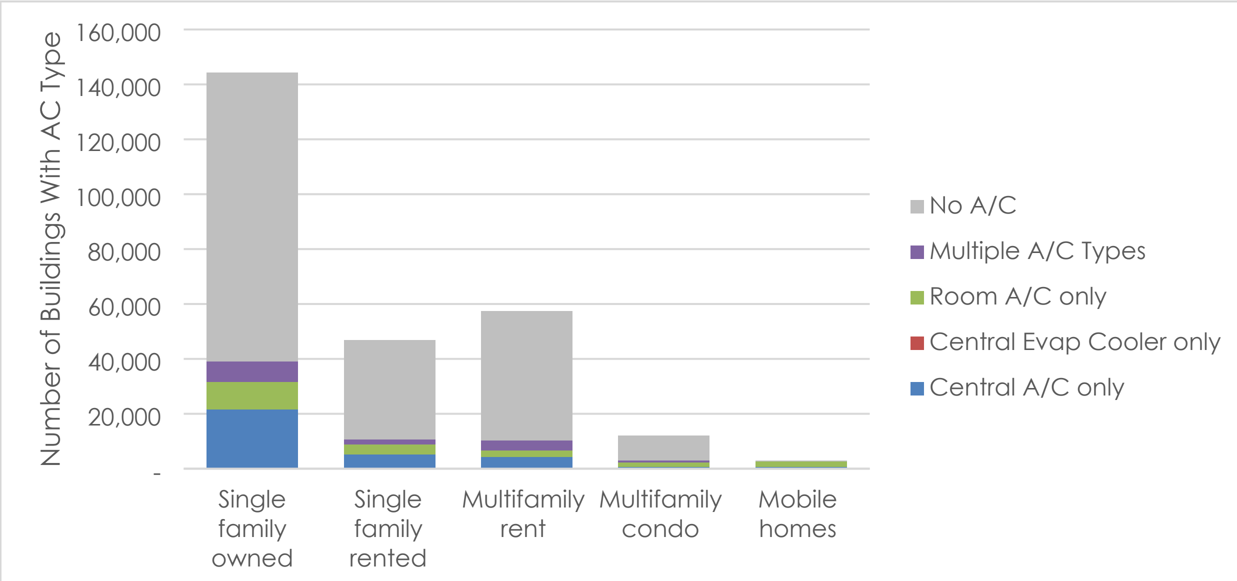


Data Source: Residential Appliance Saturation Survey (RASS)

Air Conditioning Prevalence and Type

Most residential buildings in San Mateo County do not have air conditioning. Those that do, mostly single-family owned homes, use central AC. The lack of air conditioning within the County is important to note as projected increases in temperatures related to climate change may increase the need for air conditioning installations as a resilience measure. This represents an important opportunity for buildings to use a "two-way" air-conditioning system or heat pump. When considering the cost of both a furnace and air conditioner, a heat pump is significantly less expensive (see cost analysis below).

Figure 8 Air Conditioning System Counts by Building Type in San Mateo County

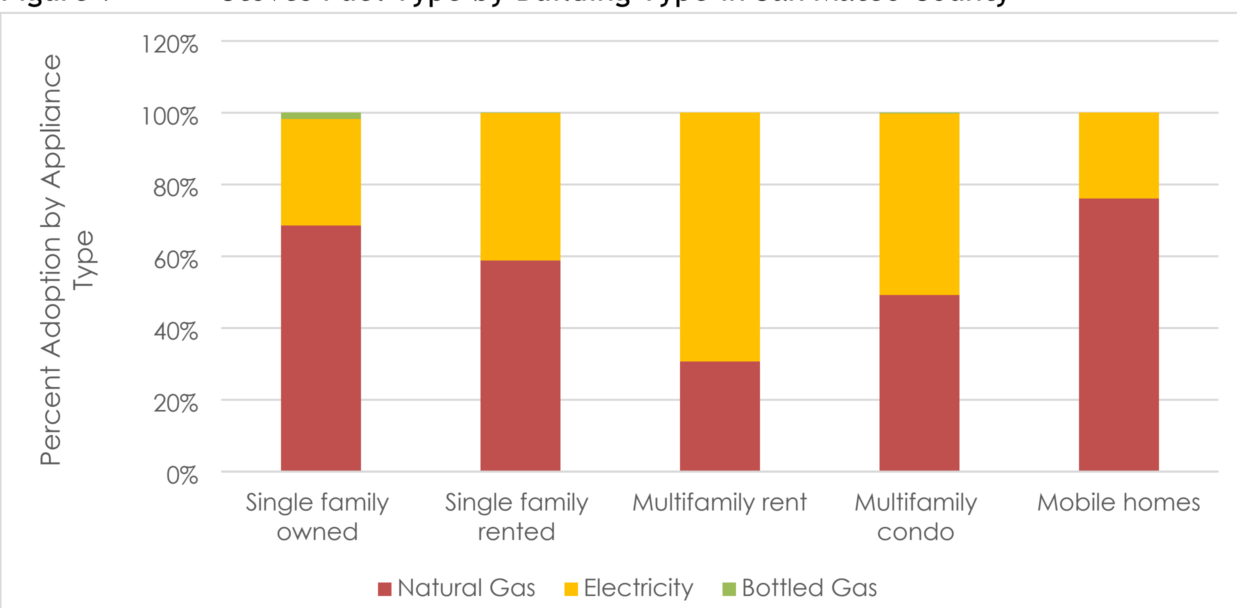


Data Source: Residential Appliance Saturation Survey (RASS)

Stove Types

Within San Mateo County, gas and propane (bottled gas) fueled units make up approximately 60% of all stoves while electric units make up the remaining 40% as shown in Figure 9 . Electric stoves are most common in multifamily rental units.

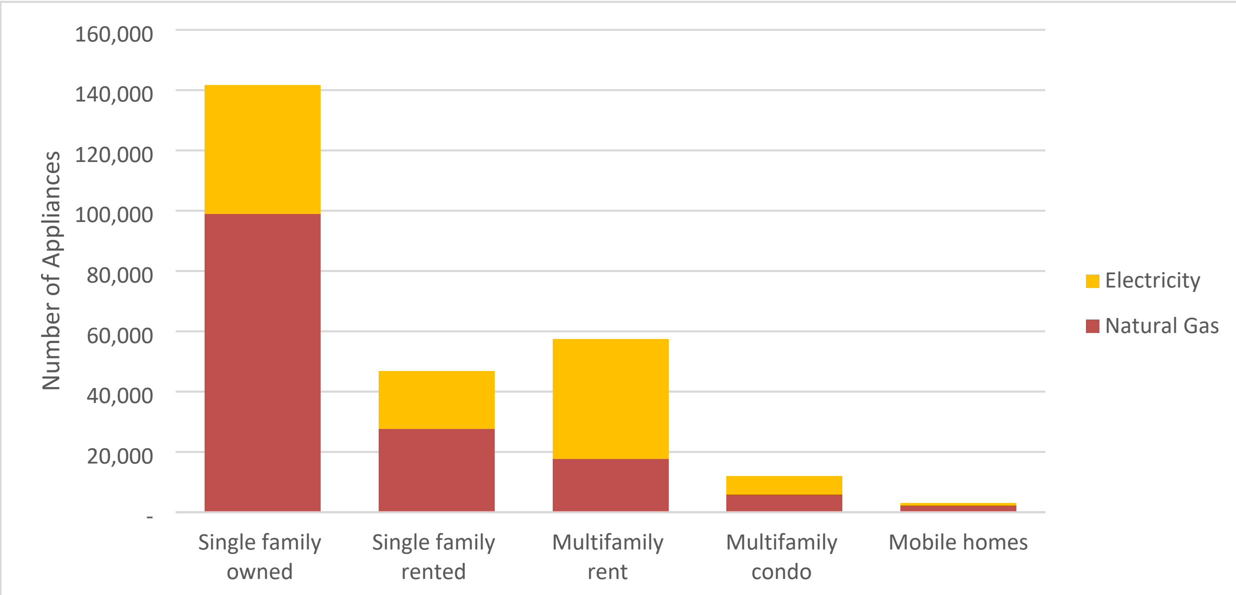
Figure 9 Stoves Fuel Type by Building Type in San Mateo County



Data Source: Residential Appliance Saturation Survey (RASS)

Figure 10 shows the total number of residential stoves in San Mateo County by fuel type and building type. Gas stoves are most common in single family units while multifamily units tend to use electric.

Figure 10 Stove Counts by Building Type in San Mateo County

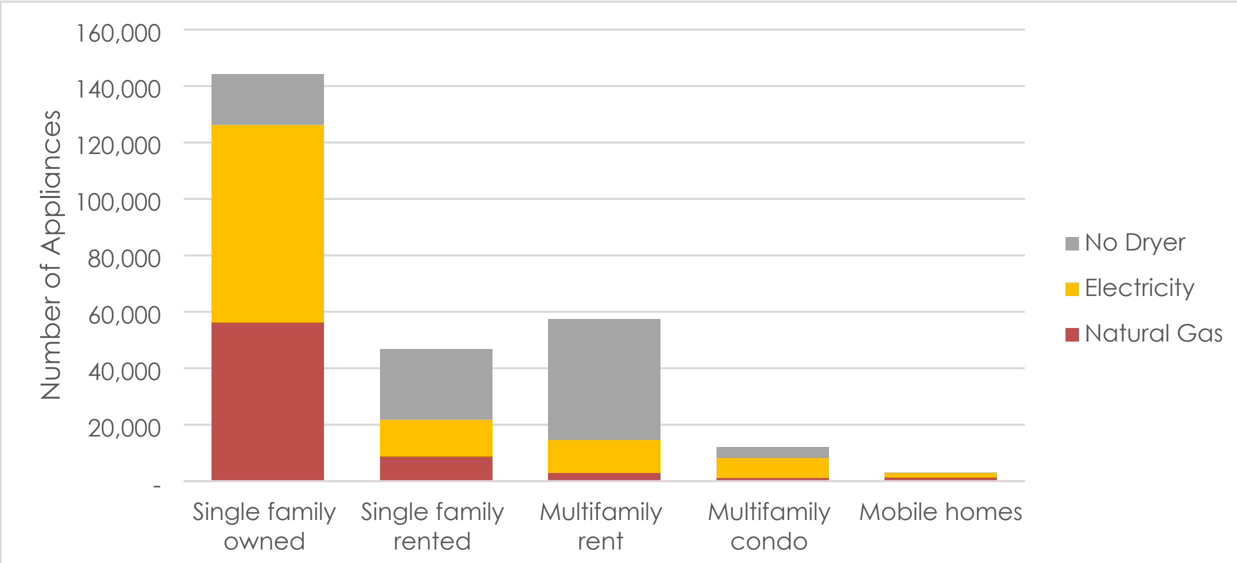


Data Source: Residential Appliance Saturation Survey (RASS)

Clothes Dryer Types

Most residential buildings in San Mateo County have a clothes dryer with dryers being most common in single family units. Electric clothes dryers make up nearly 40% of all dryer use, while only 27% are gas. The remaining 34% of units do not have a dryer on site according to the RASS data.

Figure 11 Clothes Dryer Counts by Building Type in San Mateo County



Data Source: Residential Appliance Saturation Survey (RASS)

Pools

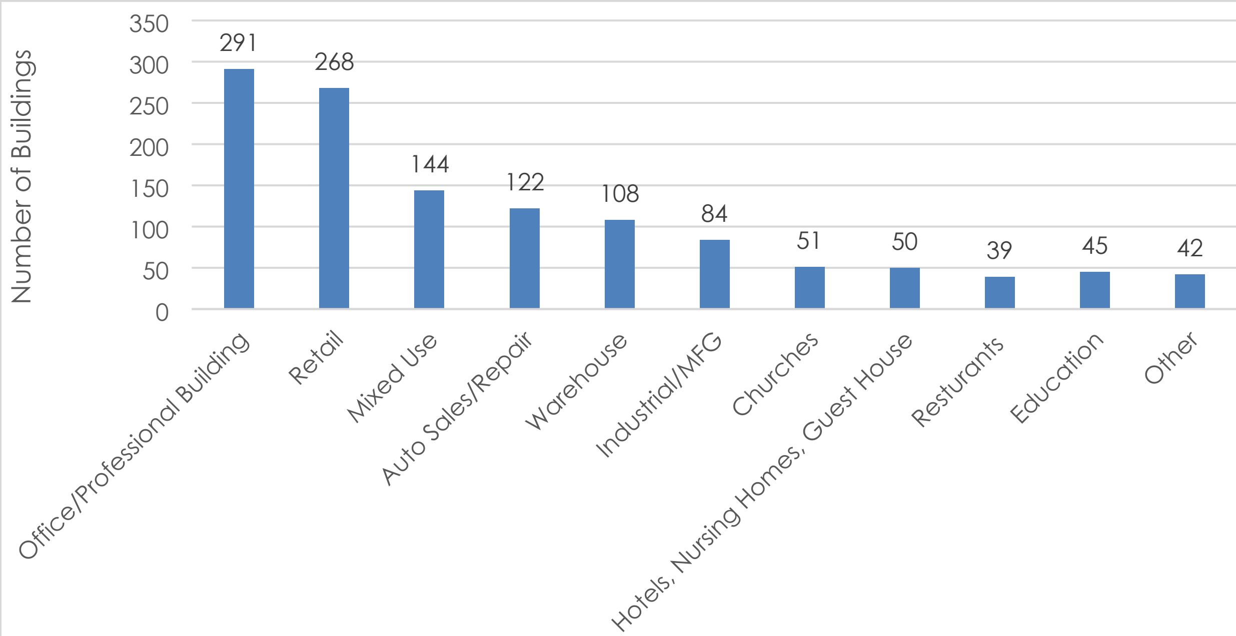
Approximately 849 residential buildings (4%) have pools within the City of San Mateo, according to PCE. Pools in the City of San Mateo are likely to be heated using gas.

PART 2: HIGH-RISE MULTIFAMILY AND COMMERCIAL BUILDING SEGMENTATION ANALYSIS

Commercial Buildings and High-Rise Multifamily Building Segmentation Analysis

Total commercial buildings (1,244 individual buildings) segregated by type based on San Mateo County parcel data are shown in Figure 12. The most common commercial building type in San Mateo is office followed by retail. Mixed use, auto sales, and warehouses make up the next most common building by total count.

Figure 12 Commercial Buildings by Type in the City of San Mateo



Data Source: San Mateo County Parcel Data

Data on commercial building energy usage by appliance/end use specific to San Mateo or San Mateo County was not available at the time of this memorandum's analysis. However, the California Energy Commission published the 2006 California Commercial End-Use Survey (CEUS) which details statewide commercial energy use. An updated 2018-2022 CEUS is likely to be released soon, though it is currently delayed due to COVID-19 related impacts. Therefore, the 2016 CEUS is the most up-to-date information available on California's commercial building energy consumption. CEUS filters results by utility which allows for some refinement, compared to the statewide results. The PG&E results are summarized below. The full report is no longer on the CEC website, but can be found here.[7]

Within the PG&E service area there are just under 2 billion square feet of commercial floor space. The building types with the largest floor area are miscellaneous with 23%, large offices with 15% and retail with 14%. Total natural gas usage from these buildings is estimated at 565 Million therms per year with three building types representing over 54% of total natural gas usage: restaurants (21%) miscellaneous (20%) and health (13%). Total electricity and gas usage by end use are shown in Figure 13 and Figure 14, respectively.

[7] https://planning.lacity.org/eir/CrossroadsHwd/deir/files/references/C19.pdf

Figure 13 Commercial Electricity by End Use (2006 CEUS)

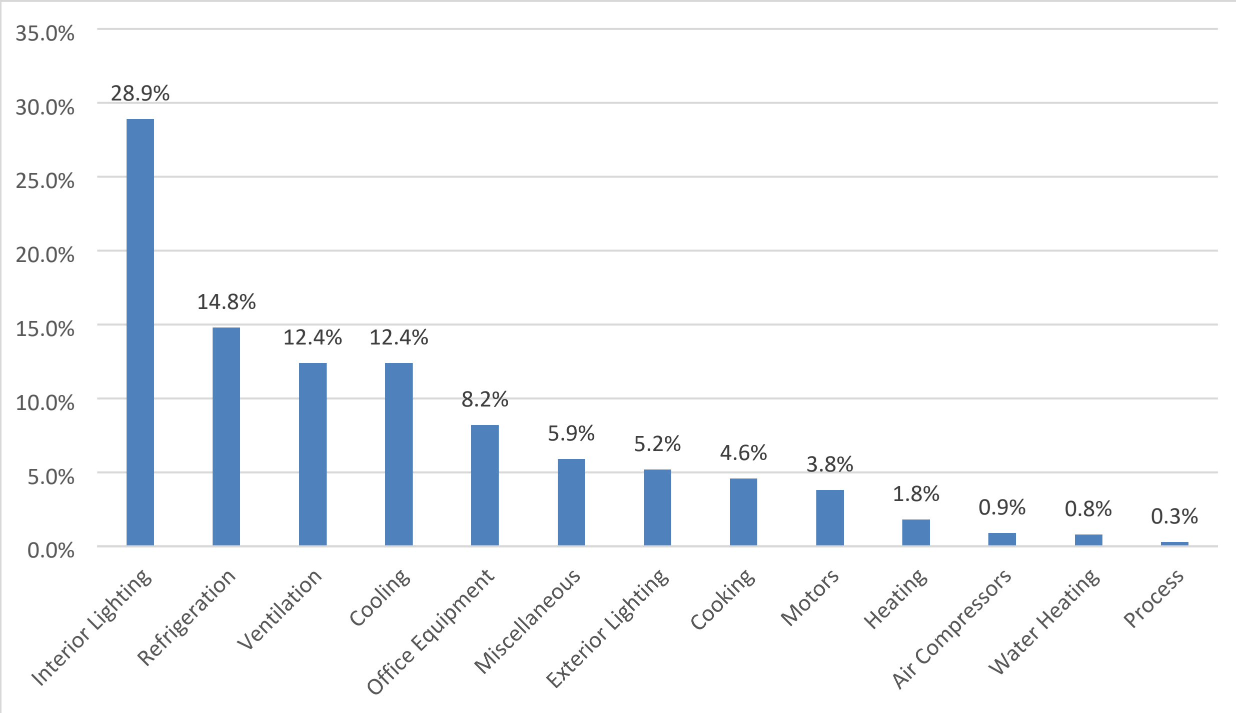
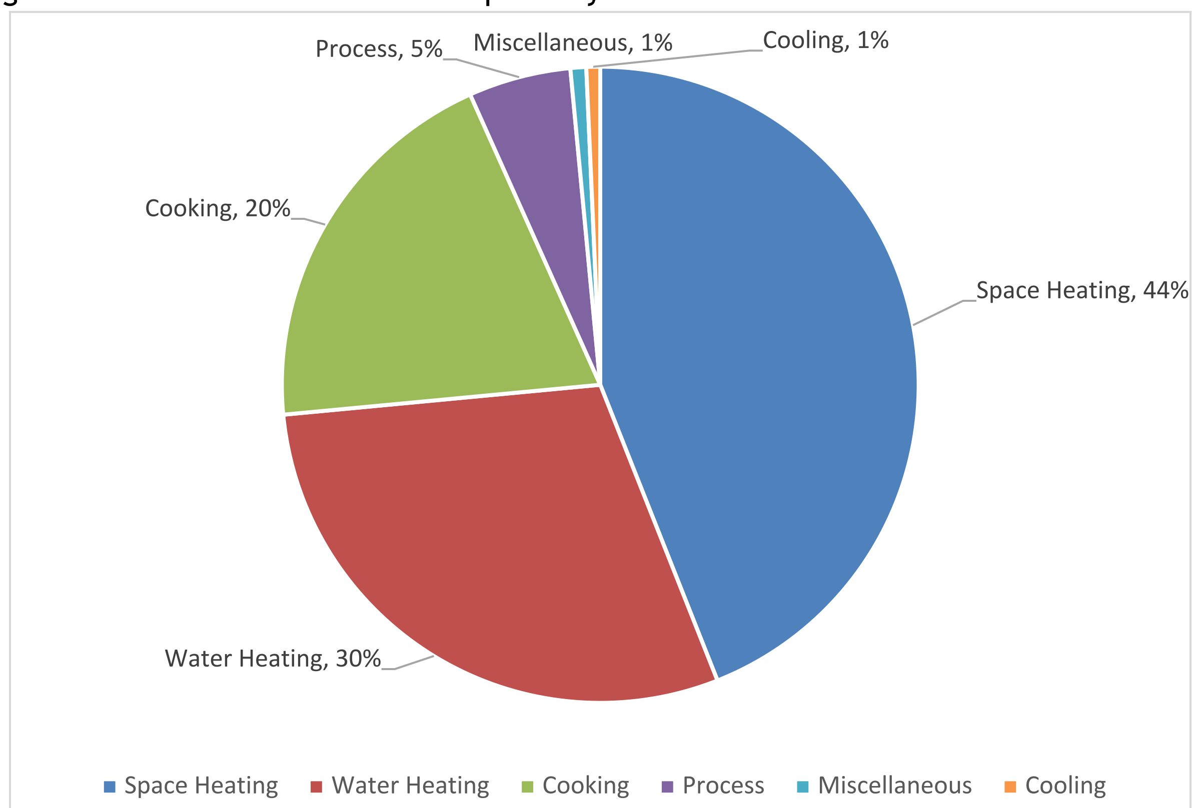


Figure 14 Commercial Gas Consumption by End Use

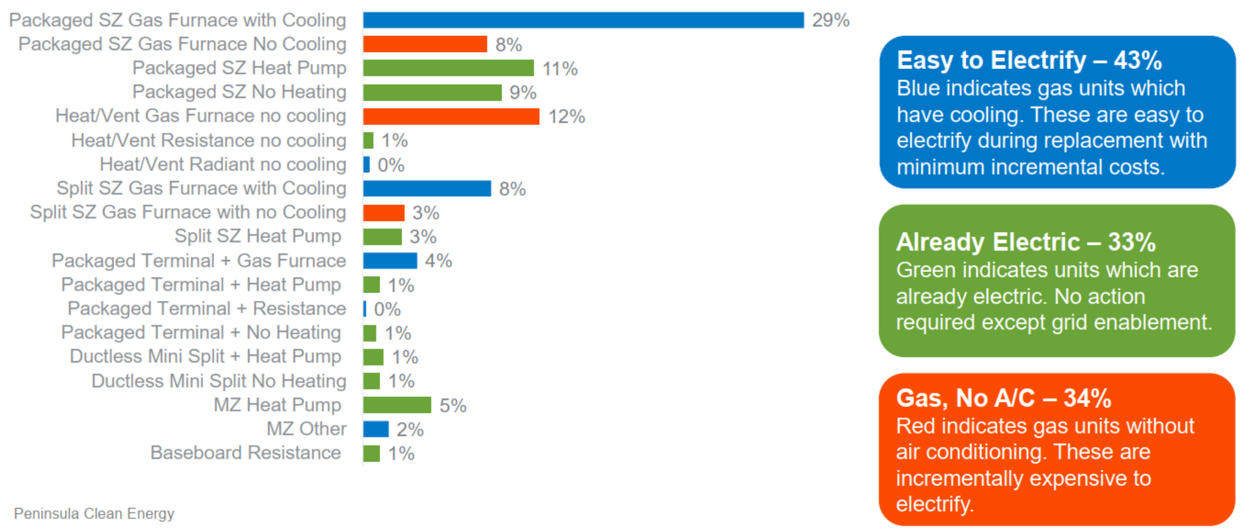


As shown in the figures above, gas is the predominant energy source for commercial space and water heating with less than 1% of all electricity being used for commercial water heating and less than 2% of electricity being used for space heating.

Commercial Space and Water Heating Types

The CEUS does not provide energy consumption by type of space and water heating equipment. However, PCE did provide data on equipment prevalence for commercial buildings based on Commercial Saturation Survey (CSS). Commercial Heating Ventilation and, Air Conditioning (HVAC) equipment types for San Mateo County are included in Figure 15. The majority of HVAC equipment are packaged single zone (SZ) furnaces with cooling, which are also the easiest to electrify.

Figure 15 Commercial Space Heating Equipment Prevalence by Type in San Mateo County (PCE)

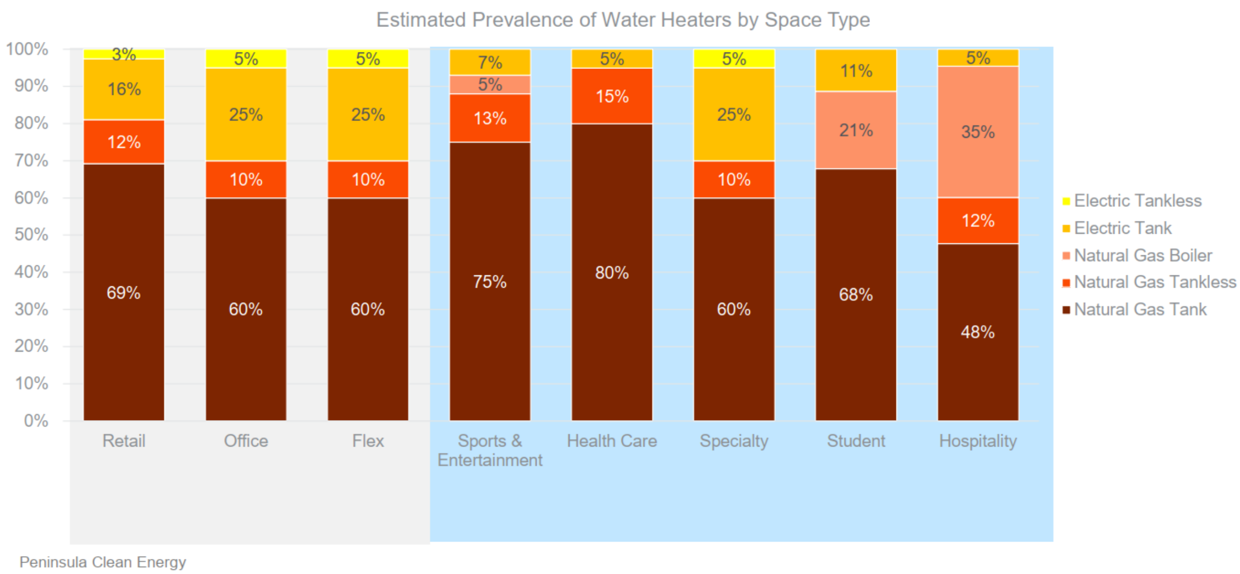


Data Source: PCE 2035 Decarbonization Plan

PCE also provided information on commercial water heating. Water heating equipment is broken down into five categories with a mix of both gas and electric appliances being present in commercial buildings within the County. Most of these systems are natural gas tank water heaters, as shown in

Figure 16.

Figure 16 Commercial Water Heating Equipment Prevalence by Type in San Mateo County (PCE)



Data Source: PCE 2035 Decarbonization Plan

PART 3: RESIDENTIAL AND COMMERCIAL BUILDINGS ELECTRIFICATION COST ANALYSIS

Electrification Up-Front Costs - Single-Family and Low-Rise Multifamily Buildings

Up-front costs include the costs to purchase an appliance, install it, and make it operational. Up-front costs to electrify were analyzed using the most recent and location specific data available. Third party vetted sources from local government and community choice aggregator (CCA) reports and data sets specific to the City and County of San Mateo were used for most data sources. Sources for each data set used in the analysis are summarized in

Table 1 below.

For most up-front costs, median install values were selected to inform the cost analysis. Using median costs helped remove outlier quotes from contractors, which would have influenced the average value. Quotes for some equipment, such as HVAC units, could vary by as much as $15,000 for the same project.

Where there are exceptions to this data filtering process, due to missing data, data substitution methods will be clarified in the relevant cell of the analysis.

Table 1 Data Sources Analyzed for Single Family Cost Analysis

Author/Source	Source Description	Analysis Use and Considerations
Peninsula Clean Energy (PCE)	2035 Decarbonization Feasibility Analysis & Plan: Complete Analysis and Draft Plan (September 2022)[8]	Electric and gas appliance installation costs, including wiring, appliance cost, labor, and markup. Commercial rooftop package unit cost data.
Josie Gaillard & Tom Kabat via funding from BayREN & County of San Mateo Office of Sustainability	Decarbonizing Single Family Homes (January 2023)[9] Single-Family Home Decarbonization Case Study: San Mateo 1-Story Home (March 2023)[10]	Electric and gas appliance installation costs (all-cost inclusive), based on specific equipment and models, bids for 10 homes under consideration as part of cumulative case study. One City of San Mateo Single-Family Home case study analyzed.
BayREN Contractor Install Dataset	BayREN Contractor-Input Raw Data for Electric Appliance Installation (Excel), filtered for most recent year input (2022)	This raw data source was also used to inform the PCE 2035 Decarbonization Feasibility Analysis and Plan
TECH Clean California Install Dataset	TECH Clean California Install Dataset-Input Raw Data for Electric Appliance Installation (Excel), filtered for most recent year input (2022)	This raw data source was also used to inform the PCE 2035 Decarbonization Feasibility Analysis and Plan

Note: Existing datasets and reports did not cover the cost of air conditioning (both appliance and installation), which was found using desktop research (Angie's List), filtering for location-specific costs[11]

Low Rise Multifamily Applicability

In general, the costs for single family homes and the costs per unit for low rise multifamily homes (3 stories and under) will be similar. Low rise multifamily homes tend to use similar equipment and one piece of equipment (such as a hot water heater or furnace can serve one or multiple units). In some low-rise multifamily units there may be a single larger piece of equipment shared between multiple units (an example would be an 80 gallon hot water heater being used by both units in a duplex). Therefore, the per unit costs for electrification in Table 3 are assumed to be conservative for multifamily buildings which use residential (as opposed to commercial) sized equipment. High rise multifamily homes (over 3 stories) look more like commercial buildings with a wide variety of equipment and the potential for larger centralized systems, which will be described further in **Note that IRA incentives take the form of tax credits, while other rebates can be applied upfront by the building owner or contractor after completing program documentation requirements. Please refer to Table 6 for a full summary of rebates and incentives by funder.*

High-Rise Multifamily and Nonresidential Building Costs.

[8] https://www.peninsulacleanenergy.com/wp-content/uploads/2022/01/2022.09-BOD-2035-Decarb-Plan-Complete-Analysis-Draft-Plan-1.pdf
[9] https://www.smcsustainability.org/wp-content/uploads/Decarbonizing-Single-Family-Homes.pdf
[10] https://www.smcsustainability.org/energy-water/decarbonizing-homes/cost-plans/
[11] https://www.angi.com/articles/how-much-does-installing-new-ac-cost.htm

Up-Front Costs for Electrification

- **Key figure highlight**: Whole home electrification could be less expensive for building owners in San Mateo than replacing appliances with gas once rebates are included.
  - Full-home appliance replacement with new gas appliances: $11,012 - $18,512[12]
  - Before incentives: Full-home appliance replacement with new electric appliances[13] marginal cost: $13,291- $20,936[14]
  - After incentives: Full-home appliance (no AC) replacement with new electric appliances marginal cost: +$709 in cost savings – $4,836[15] and get the benefit of air conditioning.
  - After incentives: Homes with AC + Furnace that need replacing could save up to $2,665

To understand the up-front costs of electrification, Rincon gathered data through existing analysis described in

Table 1 to determine the cost to install new gas appliances as well as new electric appliances. These costs were all-inclusive, incorporating wiring upgrades, labor costs, appliance costs, permitting, and contractor markup.

Rincon assumed that in an electrification scenario for a home, switching any gas appliances to an electric appliance would only occur if the gas appliance no longer functioned or was due for replacement ('burnout'), for other consumer preference reasons (ex. public health, climate consciousness), or was voluntarily upgraded to a modern electric option. Because of this *electrify on replacement* scenario, Rincon further determined the marginal cost of the electrification scenario by comparing:

- Gas to gas "like for like" scenario- an old gas appliance is replaced with a new similar gas appliance.
- Gas to electric "electrification" scenario- an old gas appliance is replaced with a new similar electric appliance.

The marginal cost is the difference between the electrification scenario, and the gas to gas, or "like for like" scenario. By focusing on the time of replacement the cost of electrification is the difference between a standard gas replacement and an electric upgrade. While some building owners may opt to replace their appliances before burnout in order to gain the benefits of electrification (improved air quality, lower GHG emissions, bill savings) most people are expected to wait until burnout to replace their appliances. Therefore, while both gross and marginal costs are included in this

[12] Low scenario does not include AC, high scenario does include AC (in addition to a gas powered furnace)
[13] Also known as 'electrification'
[14] This scenario does not include air conditioning, which would subtract $7,500 from both scenarios as a heat pump would displace the need to install an AC in addition to a gas fired furnace.
[15] Low scenario = Total costs with no panel upgrade with low-cost HVAC scenario and no AC, median HVAC scenario

memorandum, the marginal cost described in detail in Table 7 7 should be the focus for determining cost effectiveness.

In reviewing the San Mateo existing data, there were four key factors that determine costs for home electrification that were apparent in the literature and data:

- Avoiding panel upgrades through a watt diet[16], panel management, or home electrification plan could result in significant savings ($3,700) for home electrification, though building owners may want to consider that installing future charging capacity for an electric vehicle may necessitate a panel upgrade anyway.[17]
- HVAC appliance costs and HVAC installation costs made up the largest single cost of electrifying a building. The cost range for HVAC installation was also the largest with quotes for the same HVAC system ranging by as much as $15,000. This variability emphasizes the need to get multiple quotes is very important.[18]
- The large cost range for HVAC equipment necessitated the Project Team running both a low-cost and median cost for electric heat pump HVAC System, which had a $3,944 difference between scenarios.
- Labor costs and quotes from contractors are likely the most expensive and variable factor in home electrification, not appliance cost.[19]

[16] Watt Diet refers to the practice of minimizing the peak electricity demand through smart chargers and other technology to avoid a panel upgrade.
[17] https://www.smcsustainability.org/energy/decarbonizing-homes/
[18] PCE 2035 Decarb Plan Analysis
[19] https://www.peninsulacleanenergy.com/wp-content/uploads/2022/01/2022.01.13-CAC-2035-Decarb-Feasibility-Plan.pdf

Electrification Scenario: Gas to Gas "Like for Like" Upfront Costs

In the gas 'like for like' scenario (base case), where it is assumed that the building owner replaces existing natural gas appliances with new gas-fired appliances, the typical whole-home cost in San Mateo, without air conditioning[20] is $11,012. Once costs for air conditioning are added in, the total projected cost to replace all appliances that run on gas plus an AC is $18,512. This analysis demonstrates the amount of money that building owners would spend as a baseline if they planned on replacing their appliances.

These costs describe all up-front costs for installation, appliance, and labor, by taking the average of collected median values for appliance types, while aggregating appliance types by end use (with the exception of AC, described in the note below Table 2).

Table 2 Like-for-Like Scenario: Replace Gas Appliances with Similar, New Gas Appliances (Total Costs)

Appliance, Install, Wiring	End Use	Median/Average Cost (All Data)
Gas-fired water heater	Water Heating	$2,800
Gas-fired HVAC system	Space Heating	$6,132
AC (keep existing furnace) *	Space Cooling	$7,500
Gas-fired dryer	Clothes Drying	$925
Gas-fired stove	Cooking	$1,155
Whole-Home Cost w/o AC		**$11,012**
Whole-Home+ AC		**$18,512**

* Note: Existing datasets and reports did not cover the cost of air conditioning, which was found using desktop research (Angie's List), filtering for location-specific costs by zip code, refers to central air conditioner.[21] The air conditioner (AC) uses electricity not gas to operate.

Electrification Scenario: Gas to Electric – No Incentives Applied Upfront Cost

In the gas to electric scenario (electric scenario) where it is assumed that the building owner replaces existing natural gas appliances with new electric appliances, the total whole-home electrification cost to replace all gas-powered appliances with all-electric, with no incentives or rebates applied, is:

Assuming that home electrification **does not** require an electric panel upgrade[22]:

[20] According to the 2035 Peninsula Clean Energy Decarbonization Analysis, only 25% of homes in San Mateo County have Air Conditioning, with central air conditioning being the most common type of air conditioner.

[21] https://www.angi.com/articles/how-much-does-installing-new-ac-cost.htm

[22] As discussed in the BayREN Decarbonizing Single-Family Homes Case Study, potentially costly electric panel upgrades are frequently recommended by contractors without first understanding the many potential avenues to avoid this cost through maximum usage of existing service capacity. The amp cutoff for electric panel upgrade is widely understood to be 100 amps or higher- a building with below 100 amps likely will need a panel upgrade to accommodate all-electric appliances. The BayREN Decarbonization Case Study recommends several ways for "panel optimization", including making a whole home electrification plan, and investing in circuit sharing and pausing infrastructure instead of a panel upgrade.

- $24,303-$28,248

Assuming that home electrification **does** require an electric panel upgrade (particularly for homes with electric panels less than 100 amps):

- $28,003-$31,948

The difference between both electric panel scenarios described above is the difference between the 'low' and 'median' heat pump scenario, which was broken out to detail the significant difference in installation bids for electric heat pump HVAC systems. This discrepancy in installation bids from contractors stems from home-specific needs for ductwork upgrades, locations to house HVAC systems, and labor costs which are highly variable depending on the contractor. These two scenarios show that installation costs for HVAC and the potential need for an electric panel upgrade are two of the largest influencers of cost in home electrification for the City of San Mateo.

These costs can be significantly or partially offset by stacked federal and local incentives as described in the

Table 5 Full-Home Electrification (Replace All Appliances with Electric) Marginal Cost Scenarios

Full-Home Electrification (replace all appliances with electric) Marginal Cost- No AC Cost Savings	
Low-Cost Heat Pump (HP) HVAC Scenarios - No AC	
Full-home electrification (w/o AC or panel Upgrade)	$13,291
Full-home electrification marginal cost (w/o AC with Panel upgrade)	$16,991
Median-Cost Heat Pump (HP) HVAC Scenarios - No AC	
Full-home electrification marginal cost (w/o AC or panel upgrade)	$17,236
Full-home electrification marginal cost (w/o AC with Panel upgrade)	$20,936
Full-Home Electrification (replace all appliances with electric) Marginal Cost - With AC Cost Savings	
Full-home electrification, with AC, no panel upgrade, low cost HP	$5,791
Full-home electrification, with AC, no panel upgrade, median cost HP	$9,736
Full-home electrification, with AC, panel upgrade, low cost HP	$9,491
Full-home electrification, with AA, panel upgrade, median cost HP	$13,436

Current Incentives for Electrification section below. Whole home costs for replacing gas appliances with electric with no incentives applied are shown below in Table 3,

Table 3 Electrification Scenario: Cost to Replace Gas Appliances with Electric Appliances (No Incentives, Total Costs)

Appliance, Install, Wiring*	End Use	Median/Average Cost (All Data)
Electric heat pump water heater	Water Heating	$6,000
Electric heat pump HVAC system (heating and cooling)	Space Heating/Cooling - Median Scenario	$17,910
	Space Heating/Cooling- Low Scenario	$13,965
Electric dryer	Clothes Drying	$1,963
Electric stove	Cooking	$2,375

Panel Upgrade (Only if needed)	Electrical (additional one-time costs)	$3,700
Low Cost HVAC Scenario: Whole-Home Cost (w/o panel upgrade)		$24,303
Low Cost HVAC Scenario: Whole-Home Cost (+ panel upgrade)		$28,003
Median Cost HVAC Scenario: Whole-Home Cost (w/o panel upgrade)		$28,248
Median Cost HVAC Scenario: Whole-Home Cost (+ panel upgrade)		$31,948

Electrification Scenario: Marginal Costs (Difference Between Gas and Electric Install Costs)

'Marginal costs' for electrification are at the core of this analysis as they describe the cost difference between the assumed investment needed to replace a gas appliance that would happen during 'burnout' or equipment upgrade with all-electric technologies. Put simply, marginal costs describe how much more expensive it would be to go all-electric, rather than replace non-functioning appliances with gas. Zeroing out this difference between electric and gas install costs would mean that electrifying does not increase the cost burden on building owners in San Mateo when compared to the baseline 'gas for gas' replacement, addressing a key cost and equity hurdle for developing existing building electrification policies.

Assuming that the home electrification scenario replaced a combined furnace and AC with a heat pump[23] , the marginal cost to electrify (without incentives) would range from:

- $5,791-$9,736

[23] This would entail subtracting out the additional cost of replacing an AC, as a heat pump provides both heating a cooling functions, functionally displacing the need to replace both a gas-powered furnace and an air conditioner under the 'like for like' scenario

Assuming that the home electrification scenario does not have AC/does not want AC, and also does not require a panel upgrade, marginal costs to electrify before rebates would range from:

- $13,291-$17,236
  - This cost range for both scenarios is based on the install difference between low and median heat pump HVAC systems
  - If an electric panel upgrade was added, $3,700 would be added to each cost range scenario

Marginal costs for replacing gas appliances with electric, with no incentives applied are shown below in Table 4 by appliance type and end use, and with different full-home electrification scenarios with and without air conditioning cost savings, panel upgrades, and low and median cost heat pump scenarios included in Table 5.

Table 4 Electrification Scenario Marginal Costs (Appliance Level)

Appliance	End Use	Median/ Average Cost
Electric heat pump water heater	Water Heating	$3,200
Without AC: Electric heat pump HVAC system	Space Heating/Cooling: Median Cost Scenario	$11,778
	Space Heating/Cooling: Low-Cost Scenario	$7,833
With AC: Electric heat pump HVAC system (heating and cooling; replaces need for additional AC)	Space Heating/ Cooling	$(7,500)
Electric dryer	Clothes Drying	$1,038
Electric stove	Cooking	$1,220
Additional One-Time Costs: Panel Upgrade		$3,700

Table 5 Full-Home Electrification (Replace All Appliances with Electric) Marginal Cost Scenarios

Full-Home Electrification (replace all appliances with electric) Marginal Cost- No AC Cost Savings	
Low-Cost Heat Pump (HP) HVAC Scenarios - No AC	
Full-home electrification (w/o AC or panel Upgrade)	$13,291
Full-home electrification marginal cost (w/o AC with Panel upgrade)	$16,991
Median-Cost Heat Pump (HP) HVAC Scenarios - No AC	
Full-home electrification marginal cost (w/o AC or panel upgrade)	$17,236
Full-home electrification marginal cost (w/o AC with Panel upgrade)	$20,936
Full-Home Electrification (replace all appliances with electric) Marginal Cost - With AC Cost Savings	
Full-home electrification, with AC, no panel upgrade, low cost HP	$5,791

Full-home electrification, with AC, no panel upgrade, median cost HP	$9,736
Full-home electrification, with AC, panel upgrade, low cost HP	$9,491
Full-home electrification, with AA, panel upgrade, median cost HP	$13,436

Current Incentives for Electrification

Depending on project availability, current appliance electrification incentives available through the Inflation Reduction Act (IRA), Peninsula Clean Energy (PCE), BayREN, TECH Clean California when combined make building owners eligible for $21,600 in rebates, which are summarized in Table 66. Incentives take the form of both rebates and tax incentives. Tax incentives through the IRA require the building owner to have some tax burden to reduce.

Data for existing rebates were collected from most recent online sources on existing federal-level (IRA[24]), local (PCE[25], BayREN[26], TECH Clean California[27]) sources of home electrification rebates.

[24] https://www.rewiringamerica.org/IRAguide
[25] https://www.peninsulacleanenergy.com/residential-programs/
[26] https://www.bayren.org/articles-tools-tips/electrification
[27] https://switchison.org/

Table 66 Current Incentives (as of August 2023)

Appliance	End Use	$ Rebate/ Tax Credit* Available	Funder	Notes
Electric heat pump water heater	Water Heating	$3,000	PCE	Stackable with other incentives, but most cannot exceed cost of projects; All PCE- capped at $14,000
		$1,000	BayREN	All BayREN- capped at $7750
		*$2,000**	IRA	Max for IRA 30% heat pump water heater tax incentive ($2000) max, must have paid taxes in calendar year. Additional low-middle income IRA incentives are upcoming but not included here.
Heat Pump Water Heater Total Stackable Rebates and Tax Credits Available		**$6,000**		
HVAC System	Space Heating/ Cooling	$3,500	PCE	Stackable with other incentives, but most cannot exceed cost of projects
		$1,000	BayREN	
		*$2,000**	IRA	Tax Credit, same as description for electric heat pump water heater
		$1,000	Tech	Single family incentives of $1,000 for new heat pump HVAC systems, with up to two incentivized systems per home for a total of $2,000; must be a TECH-enrolled contractor; project must be a non-heat pump to heat pump installation; no new construction, retrofits only; equipment must be AHRI matched systems; equipment must meet Title 24 code minimum standards.
HVAC System Total Stackable Rebates and Tax Credits Available		**$7,500**		
Electric dryer	Clothes Drying	$250	BayREN	Specifies heat pump clothes dryer
Electric Dryer Total Stackable Rebates and Tax Credits Available		**$250**		
Induction Stove	Cooking	$250	BayREN	specifies Induction Range
Induction Stove Total Stackable Rebates and Tax Credits Available		**$250**		
Additional One-Time Costs - Panel and New Circuits		$1,500	PCE	
		*$600**	IRA	Tax credit for panel upgrades- available in conjunction with other home upgrades (ex. weatherization, electrification, solar)
Electric Panel Total Stackable Rebates and Tax Credits Available		**$2,100**		
Total electric home rebates available	All-systems	$5,500	Tech	Single Family - Each single-family property (includes duplex, townhomes, and manufactured homes) must install heat pump space heating, heat

		pump water heating, electric or induction cooking, and an electric dryer.
Electric Panel Total Stackable Rebates and Tax Credits Available	$5,500	
Total Electrification Incentives (Rebates + Tax Credits) Available	$21,600	
Total Electrification Rebates Available $	$17,000	
Total Electrification IRA Tax Credits Available $*	$4,600	

**While rebates can be applied upfront by either the building owner or contractor, depending on the incentive program, IRA tax credits can be deducted from total taxes owed, meaning that the building owner would have to wait until tax season to receive the full cost reduction to electrify*

Rincon Consultants, Inc.
449 15th Street, Suite 303
Oakland, California 94612
510-834-4455

Federal Electrification Incentives under the Inflation Reduction Act (IRA) & the High Efficiency Electric Home Rebate Act[28]

The IRA was signed into law on August 2022, ushering in significant federal policy support and funding for building decarbonization. The High Efficiency Electric Home Rebate Act (HEEHRA) is the official name of the IRA's rebate program for electric home technology including heat pumps, electrical wiring, and induction stoves, which will be available starting in 2023. Low-income households up to 80% of Area Median Income (AMI) can access 100% of upfront discount incentives, while moderate-income households from 80-150% AMI can access up to 50% of the upfront discount, in addition to tax credits that vary based on household income. Total HEEHRA discounts are capped at $14,000 across all electrification projects.

Cost reductions under HEEHRA are not included in this analysis as details are still developing and the incentives may not be available to everyone, as City of San Mateo building owners are generally classified as high income. However, for low and moderate-income households up to 150% of AMI in San Mateo, IRA incentives may further increase the effectiveness of local electrification incentives available via PCE and BayREN, and help to close the gap for appliances where subsidies don't always zero-out marginal costs, like HVAC systems, dryers, and induction ranges.

Electrification Upfront Costs with Incentives Applied

In the final piece of the cost analysis, we have applied the rebates described in Table 66 to the marginal costs described in Table 4 to see if rebates and tax incentives can make electric technologies the same, or less costly than the gas scenario. For this analysis, the referenced $5,500 total home electrification rebate provided by Energy Smart Homes California was not applied since it requires a complete home electrification project at one time. Since this analysis focuses on time of replacement, this rebate was not applied to the analysis.

The analysis shows that with the low-cost scenario for HVAC applied, in a house without AC, when all incentives are stacked, total costs without a panel upgrade, electrification could save building owners in San Mateo $709. If a home has both a furnace and AC to replace, fully electrifying would save **$2,665** in marginal costs even with a panel upgrade, since one heat pump would replace two appliances.

On the high end of the marginal costs + incentives range, electrifying a home without AC, with a panel upgrade, under the Median HVAC cost analysis scenario, would be $4,836 more expensive than a gas-for-gas scenario. These results are summarized in Table 7 7.

[28] https://www.rewiringamerica.org/IRAguide

PCE Zero Percent Loans

In addition to these rebates, PCE offers up to $10,000 in zero percent loans to electrify gas water heaters, gas heaters/furnaces, panel upgrades, and efficiency upgrades (insulation, air sealing, duct replacements, and smart thermostats). These loans allow PCE-customers who are property owners to borrow up to $10,000 in 0% APR loans to electrify with a 2-10 year payback period.[29]

[29] https://www.peninsulacleanenergy.com/zero/

Table 7 7 Electrification Marginal Up-Front Costs + Incentives*

Appliance	Cost Estimate	Combined Incentives	Total Marginal Cost with Incentives
Electrification Scenario Marginal Cost with Peninsula Clean Energy, BayREN, IRA Incentives			
Electric heat pump water heater	$3,200	$(6,000)	$(2,800)
Without AC-Low Cost HVAC	$7,833	$(7,500)	$333
Without AC- HVAC system	$11,778	$(7,500)	$4,278
With AC- HVAC System	$4,278	$(7,500)	$(3,222)
Electric dryer	$1,038	$(250)	$788
Electric stove	$1,220	$(250)	$970
Additional One-Time Costs - Panel and New Circuits	$3,700	$(2,100)	$1,600
Total Costs no panel upgrade low Cost HVAC No AC			**$(709)**
Total Costs No Panel Upgrade Median HVAC no AC			**$3,236**
Total Costs W/ Panel Upgrade Median HVAC w/o AC			**$4,836**
Total Costs and Panel Upgrade Median HVAC with AC			**$(2,665)**

**Note that IRA incentives take the form of tax credits, while other rebates can be applied upfront by the building owner or contractor after completing program documentation requirements. Please refer to Table 66 for a full summary of rebates and incentives by funder.*

High-Rise Multifamily and Nonresidential Building Costs

To better understand costs and other constraints related to multifamily and nonresidential building electrification, Rincon reviewed best-available existing resources on this topic, namely, the PCE 2035 Decarbonization Plan (2022), and The Rocky Mountain Institute The Economics of Electrifying Buildings: Medium Size Commercial Retrofits (2022)[30]. This document review is also supplemented by original contractor interviews conducted by Rincon for the upcoming Sacramento Electric Buildings Strategy (2022). Though not strictly City of San Mateo specific, the technical considerations of challenges to electrify oversized buildings are consistent between Sacramento and San Mateo, so are referenced here as recent region-specific resources for commercial electrification in Northern California.

Electrification Up-Front Costs and Other Considerations

While single family and low rise multifamily residential buildings tend to use similar equipment and operate in similar ways, commercial buildings and high-rise multifamily buildings tend to be highly variable. In original research conducted by Rincon for the City of Sacramento in the summer of 2022, all interviewees[31] communicated that larger multifamily and nonresidential buildings are more complicated to electrify than single-

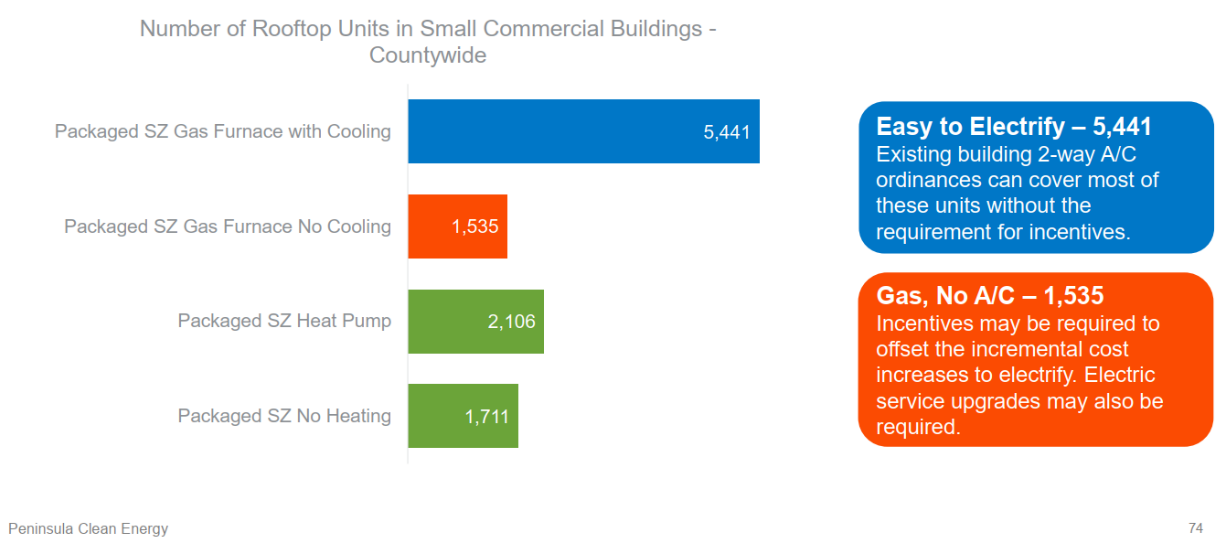
[30] https://rmi.org/insight/economics-of-electrifying-buildings-medium-size-commercial-retrofits/

[31] To better understand costs and other constraints related to multifamily and nonresidential building electrification, Rincon conducted interviews with three energy engineering consultants working on large building decarbonization in Sacramento. Five additional interviewees were identified through the City's contact network to speak to this topic, including energy managers and directors of UC Davis Health. Sacramento Municipal Utility District, Brighton Energy, Association for Energy Affordability, TRC Companies.

family homes and estimating costs is typically only possible on a project-by-project basis. This is because for most larger buildings, replacing a gas system with a similarly sized electric system is cost-prohibitive and therefore, often requires building re-engineering to determine appliance replacement and sizing options. For this reason, a detailed cost analysis for larger multifamily and commercial buildings was not developed and included here. Smaller buildings with domestic-sized space and water heating end uses, such as small to medium-sized retail or service buildings, have similar electrification costs as seen for single-family homes.

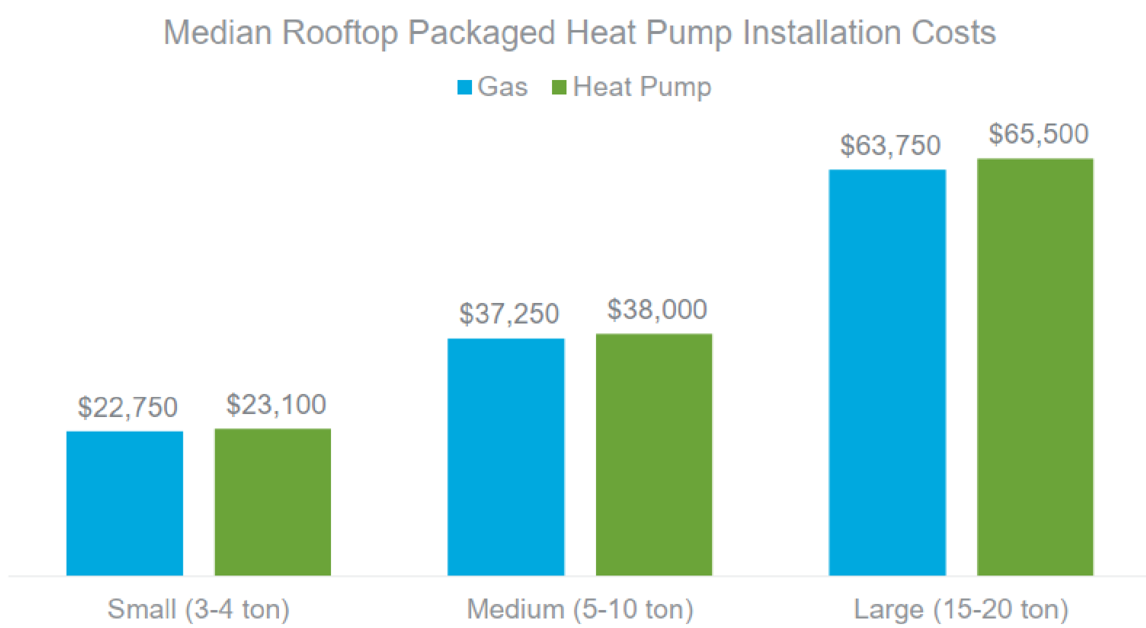
However, some equipment types are similar across building types and the cost to electrify can be more readily analyzed at a high level. The PCE analysis notes that packaged commercial HVAC equipment, namely, packaged Single Zone (SZ) Gas Furnace with Cooling, are easy to electrify, as existing building 2-way A/C ordinances can cover most units without the requirement for incentives. The PCE Analysis also notes that the Packaged SZ Gas Furnace with Cooling offers a sizable opportunity to electrify, with 5,441 Packaged SZ Gas Furnace with Cooling units across the County of San Mateo as shown below in Figure 17. Because of the relative cost parity and ease of adoption, there is already uptake of all-electric packaged SZ heat pumps, accounting for nearly 20% of analyzed existing commercial HVAC Equipment, as shown previously in Figure 15.

Figure 17 PCE 2035 Decarbonization Plan Commercial HVAC Equipment Analysis



PCE analyzed commercial rooftop packaged unit costs, finding that rooftop heat pumps are nearly identical to gas-fired rooftop packaged units, even without additional incentives, as shown below in Figure 18. This indicates that local policy and potential new incentives to retrofit using heat pump RTUs could be an impactful and cost effective strategy to achieve widespread commercial building electrification.

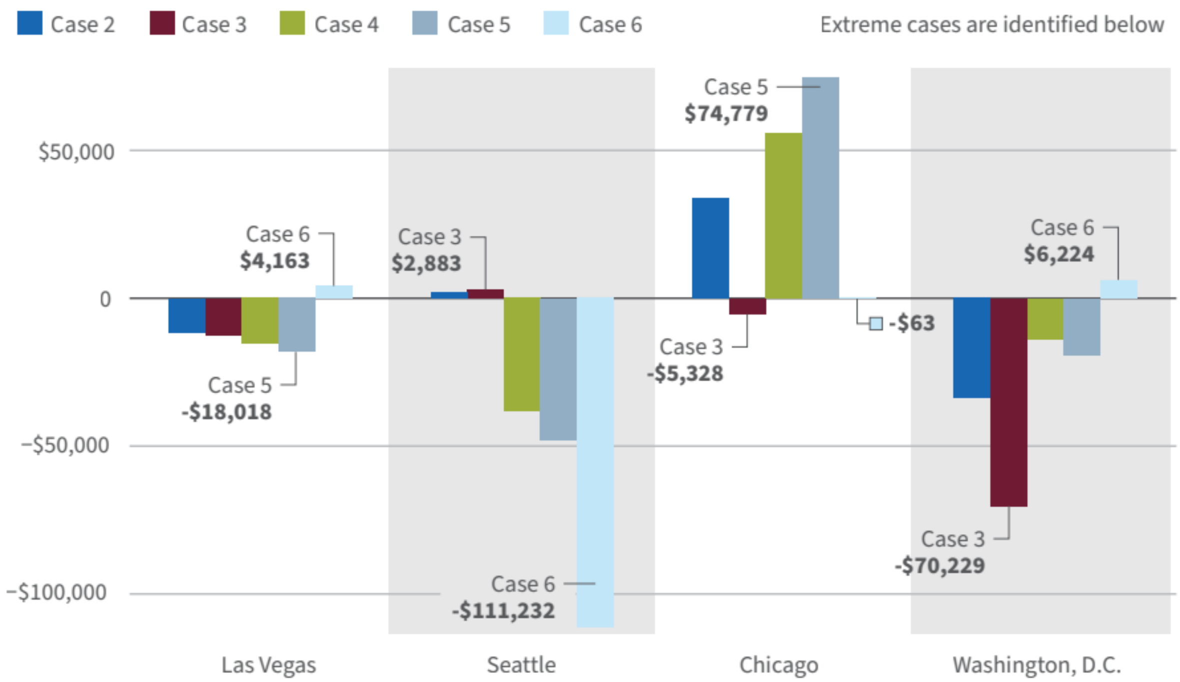
Figure 18 PCE 2035 Decarbonization Plan Commercial Rooftop Package Unit Cost Analysis



The Rocky Mountain Institute (RMI) 'The Economics of Electrifying Buildings: Medium-Size Commercial Retrofits' Report notes that local policy, or expectations of new local building electrification policies, will be a key driver in advancing commercial energy electrification, as portfolio owners will want to avoid stranded assets unless they undertake electrification. The RMI report focused on the electrification of HVAC systems from rooftop units (RTUS) with Heat Pump Rooftop Package Units (RTUs), on a prototypical 50,000 sq ft office building.

The RMI report modeled 5 cases to assess the economics of RTU retrofits: Case 1: No electrification, Case 2: Partial electrification, Case 3: Full electrification, Case 4: efficient electrification, Case 5: efficient electrification + demand management, Case 6: Efficient electrification + demand management and PV. These cases, found that in the cases of more temperate climates like Las Vegas and Seattle, building owners could achieve either neutral or positive 20-year net present value through full electrification (Seattle), or with full electrification with demand management and solar photovoltaics (Las Vegas), as shown in Figure 19.

Figure 19 RMI Report Exhibit 3: The 20-year Net Present Value of Each Case by City[32]



The results from the RMI study have three important San-Mateo-relevant takeaways, which is that 1) electrification policy, with electrification-specific prescriptive language for commercial building owners will be critical in actually electrifying commercial buildings, and 2) electrification of commercial building electric retrofits will likely have to be paired with a suite of demand management, energy efficiency, or renewable energy projects in order to make building electrification economical for building owners, and 3) heat pump rooftop package units are the most promising electrification solution for commercial building electrification, offering a replicable model for a 1:1 equipment swap-out.

Case Studies

In addition to the PCE analysis, Rincon identified all-electric retrofit case study projects related to offices, schools, and restaurants. Schools (primary and secondary), restaurants (full-service and quick-service), and hospitals represent large commercial gas users in the City of San Mateo. Case studies were pulled from The Redwood Energy Pocket Guide to All-Electric Retrofits,[33] the William J Worthen (WJW) Foundation Building Decarbonization

[32] Page 20 of: https://rmi.org/insight/economics-of-electrifying-buildings-medium-size-commercial-retrofits/
[33] Redwood Energy. June 2022. A Pocket Guide to All-Electric Retrofits of Commercial Buildings.

Practice Guide Volume 5,[34] and the California State University (CalState) Decarbonization Framework,[35] and summarized here. Rincon will continue to look for more resources in these areas as the project progresses.

Office

Immix Law Office, Portland, OR (11,615 Square Feet; All-electric Retrofit)

The building utilizes a highly efficient dedicated outside air system (DOAS) with heat recovery ventilation (HRV) for their HVAC system, which separates heating and cooling from the ventilation system to allow for optimal control of each of these critical building functions. The new HVAC system is comprised of a 16-ton Mitsubishi variable refrigerant flow (VRF) and four Ventacity VS1000RT HRVs. The HVAC system heats and cools 30 office spaces, five conference rooms, a lunchroom, exercise room, two restrooms, and open common spaces. The project resulted in increased occupant comfort, improved indoor air quality, lower energy bills (between $300 to $700 per month to heat, cool, and ventilate the building), saved roof space, and precise temperature and humidity control. The building has seen a 63% reduction in energy usage.[36]

100 Avenue of the Americas, Manhattan, NY (>20,000 Square Feet; All-electric Retrofit)

This building was retrofitted to meet all winter space heating needed for exterior offices with waste heat from the air conditioning in the interior core of the building during the winter through an all-electric multizone heat pump HVAC system. Multizone systems are best for larger (20,000 square feet or more), more diverse buildings. While only 6% of HVAC systems in California are multizone systems that could be replaced with multizone heat pump technology, these buildings represent 37% to 75% of the GHG emissions from all buildings. They are technically complex to design and require highly skilled installers but also represent the largest GHG reduction opportunities.[37]

Sonoma Clean Power Headquarters, Santa Rosa, CA (15,000 Square Feet; All-electric Retrofit)

The building was originally built in 1979 in Downtown Santa Rosa and retrofitted with all new insulation, all-new windows, all-new siding, and all-new mechanical systems. As part of the retrofit, the building installed Daikin rooftop units with variable air volume delivery and thermofusers at the zone level. The project also included its own microgrid and electric vehicle charging, which required an electrical service upgrade.[38]

[34] William J Worthen Foundation. March 2022. The Building Decarbonization Practice Guide Volume 5: All-Electric Residential + Commercial Kitchens.
[35] CalState Office of the Chancellor. 2022. CSU Decarbonization Framework.
[36] Redwood Energy. June 2022. A Pocket Guide to All-Electric Retrofits of Commercial Buildings.
[37] Redwood Energy. June 2022. A Pocket Guide to All-Electric Retrofits of Commercial Buildings.
[38] Redwood Energy. June 2022. A Pocket Guide to All-Electric Retrofits of Commercial Buildings.

School

California State University, California

The CSU Chancellor's Office released a building decarbonization framework for the CSU system, which includes tools to evaluate central plan equipment, thermal overlap calculations for each campus, and a life cycle cost calculation tool for different decarbonization strategies. The framework provides all 23 campuses with a technical roadmap for replacing fossil fuel infrastructure with clean, electrified alternatives. The associated heat recovery potential and natural gas reduction at each campus was analyzed. The Sacramento CSU campus currently uses 78,164 million British Thermal Units per hour (MBTU) for cooling and 52,739 MBTU for heating. The heat recovery potential estimated for the building after adding thermal energy storage on site is 64% and the estimated natural gas reduction potential is 422,000 therms.[39]

Chatham University Eden Hall Campus, Pittsburgh, PA (All-electric New Construction)

The campus is the world's first fully self-sustained and zero net energy (ZNE) university campus. The campus includes 46 geothermal wells, an on-campus water treatment site, and a 40-acre farm. The campus kitchen was designed based on extensive energy analysis focusing on commercial kitchen equipment and HVAC systems. The analysis showed that induction equipment would reduce total kitchen energy consumption by over 50% compared to a traditional gas kitchen. The campus also installed demand-based exhaust hoods with integrated heat recovery, a geo-exchange heat pump, and radiant heating and cooling systems for a low-energy HVAC system. The facility operates with an energy usage of approximately 60% below the typical full-service restaurant.[40]

Restaurant

Oysterman Seafood Bar & Kitchen, London, England; Retrofit (Induction Units)

The restaurant switched from gas to induction units, which allowed the restaurant to serve guests at a significantly faster rate. Gas ranges and fryers are half as efficient at transferring heat as electric ranges and fryers (35% vs. 75%), and electric ranges boil water twice as fast as gas ranges. Electric kitchens, therefore, use half or less as much heat to cook food and require half as much air conditioning. Electric equipment also takes less space to do the same amount of cooking, making it easier for a kitchen to expand its cooking capacity. In addition to these benefits, Oysterman also experienced fewer chef burns with their induction burners and found cleaning to be much easier, ultimately reducing staff turnover.[41]

Benihana Japanese Steak House, Various Locations, U.S.; Retrofit (Induction Grill)

The first Benihana steakhouse was started in New York City in 1964 and has since grown to 116 restaurants. Benihana performs teppanyaki cooking on steel grills. Recently the

[39] CalState Office of the Chancellor. 2022. CSU Decarbonization Framework.
[40] William J Worthen Foundation. March 2022. The Building Decarbonization Practice Guide Volume 5: All-Electric Residential + Commercial Kitchens.
[41] Redwood Energy. June 2022. A Pocket Guide to All-Electric Retrofits of Commercial Buildings.

restaurant chain converted its gas teppan grills to electric resistance and induction grills, which can cook meats faster, hotter, and more efficiently than gas while reducing the risk of uncontrolled fires.[42]

HOTEL MARCEL, NEW HAVEN, CT; NEW ALL-ELECTRIC CONSTRUCTION

The hotel has an all-electric commercial kitchen, which uses induction, including an induction wok setup.[43] Induction woks are not common in American commercial kitchens, however, they are becoming increasingly popular in Mainland China, Taiwan, Hong Kong, and Macau. Many commercial options exist on the market for induction cookers that can accommodate concave pans (such as woks). 15 million induction cookstoves were sold in Mainland China in 2020, with a growth of nearly 4% from the previous year.[44]

MICROSOFT REDMOND CAMPUS CAFETERIA, REDMOND, WA; NEW ALL-ELECTRIC CONSTRUCTION

The Microsoft Redmond Campus serves over 12,000 meals a day in 77,000 square feet of all-electric kitchens. The project had to overcome barriers such as equipment availability, throughput considerations, and station design. Microsoft has noted a positive response from the industry in the past few years enabling the transition for them.[45]

High-Rise Multifamily

BAYVIEW TOWER, SEATTLE, WA

The 100 unit high rise multifamily building was retrofit to be all electric using the Origin heat pump water heater system that provides all needed water heating components (heat pump, storage tank, valves, controls, etc..) on one skid to maximize ease of installation. The system is expected to reduce energy use by 59%. [46]

ELIZABETH JAMES HOUSE, SEATTLE, WA

Elizabeth James House is a four story, 60 unit low income senior apartment building built in 1968. This project had a central plan of four ECO2 heat pumps, with three existing 120 gallon tanks in a series swing configuration. In addition, the system kept the three electric water heaters, and a 175 gallon swing tank was installed.[29]

Recommendations from Interviewees

As part of the interview process for previous work with the City of Sacramento, Rincon asked contractors what recommendations they have for the City or utility provider for reducing barriers to electrification in the City. While some of these recommendations may be specific to the City of Sacramento, many of these recommendations hold for the City

[42] Redwood Energy. June 2022. A Pocket Guide to All-Electric Retrofits of Commercial Buildings.
[43] Business Wire article, accessed at: https://www.businesswire.com/news/home/20220420005918/en/The-First-Anticipated-Net-Zero-Hotel-and-First-Passive-House-Certified-Hotel-in-the-US-Slated-to-Open-This-Spring
[44] HKTDC Market Research, accessed at: https://research.hktdc.com/en/article/MzA3OTE4MTUw
[45] William J Worthen Foundation. March 2022. The Building Decarbonization Practice Guide Volume 5: All-Electric Residential + Commercial Kitchens.
[46] https://www.redwoodenergy.net/publications/redwood-energys-pocket-guide-to-all-electric-commercial-retrofits

of San Mateo, to account for the viewpoint of contractors and building developers dealing with complex commercial building stock. These recommendations included:

- Alleviate the burden on the customer for upgrading older, last-mile equipment such as transformers and services. Having to upgrade this equipment can kill a project. SMUD (in San Mateo, PG&E) could identify transformers that are already at peak capacity and deal with them pro-actively, or identify grant funds to help cover these costs.
- More workforce training and work with the unions is needed to prepare the workforce for electrification work.
- Encourage projects to build-in more hot water storage to help avoid an increased peak electrical load.
- Develop policy to avoid over-estimation of panel needs, which can trigger larger-scale electrical upgrades that are prohibitively expensive. Default calculations on equipment tend to overestimate peak load and using real data from a building instead can help avoid ballooning expenses.
- Adjusted rate structures could be an incentive for early electrification adopters, since this would help guarantee on-bill savings in many cases. Peak demand for commercial customers currently sets their billing rate. Many customers are on the edge of hitting their peak demand charge and electrification would bump them into a higher tier, creating a disincentive to electrify. A specific commercial electrification rate with a discount would help remove this barrier. This suggestion item would require coordination with PCE.
- Expedited permits could create an incentive for commercial customers to electrify, especially on smaller jobs. Ideally, the permit could be filled out online over-the-counter with a simple set of questions with a permit turn-around rate of 24 hours.
- A building performance standards approach could work well for commercial buildings. San Francisco's program is recommended as a model. San Francisco's program is self-reporting but is validated. Buildings over 10,000 square feet are required to complete a level 1 audit; buildings over 50,000 square feet are required to complete a level 2 audit, and reporting requirement is every five years. Setting up the reporting system online with simple report requirements and very low rigor at the start would help get the most buildings into the system.
- Releasing a building performance standards program under something other than an electrification strategy may be the best tactic. This approach could appear more feasible, and avoid misunderstandings on potential for mandatory upgrades.

Current Incentives

Current electrification programs and rebates are available for commercial and multi-family buildings in the City of San Mateo from PCE, TECH, and BayREN are summarized in Table 88. All residential appliance incentives described in Table 66 should also apply to multifamily residents if the applicant for rebates is also the owner of the apartment, in the case of PCE Incentives.[47]

Table 88 Current Incentives and Programs for Commercial Buildings (as of August 2023)

Description	Amount/Type	Details
Commercial Building Incentives		
Data Connect (PCE)	Technical assistance	Access or share PCE Data Connect platform to analyze facility energy data, access data to help calculate energy carbon footprint. Could be useful for future building performance standard work.
Technical Design Assistance (PCE)	Technical Assistance	Free project assistance for all-electric buildings with TRC via AllElectricDesign.org
Inflation Reduction Act (IRA) Commercial Buildings Tax Credit	Tax Credit	Tax credit for energy efficiency based on square footage (Tax Credit 179D)
Multifamily Building Incentives		
TECH Heat Pump HVAC Systems Serving Multiple Apartments	$1,000/unit	HP HVAC equipment serving multiple apartments
TECH Common area HPWH rebate	$1,800/ system	Split or packaged rooftop/ multi/position heat pump (ducted or ductless)
TECH Electrical panel upgrade	$1,400/ apartment receiving electrical upgrade	Undersized apartment electrical infrastructure is upgraded as part of an apartment's HPWH or HP HVAC Installation
BayREN Common Area HVAC	$1,000/equipment	Common area heat pump HVAC
BayREN Laundry/Common Area Heat Pump Water Heater	$1,000/equipment	Common area laundry or heat pump water heater
BayREN Heat Pump Pool Heater	$1,500/pool	
BayREN Subpanel Upgrade	$1,000/apt served	
BayREN Central/common area panel upgrade	$5,000/property	

Source : https://www.peninsulacleanenergy.com/commercial-programs/, https://techcleanca.com/incentives/multifamily-information/, https://www.bayren.org/multifamily-property-owners/building-improvements

On-Bill Costs – *analysis pending*

On-bill costs are another important piece of the overall economics of electrification. This data is currently being analyzed by PCE and will be included here once completed. Initial

[47] https://www.peninsulacleanenergy.com/wp-content/uploads/2022/09/Peninsula-Clean-Energy-Appliance-Rebates-Terms-Conditions_10.01.22.pdf

data points to the ability for building electrification to be at cost parity or cost savings with mixed fuel homes but is highly dependent on the electricity rate structure for the building.