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City Council Staff Report

From: City Manager
Report Type: ACTION ITEMS
Lead Department: Planning and Development Services

Meeting Date: September 8, 2025
Report #:2507-5020

TITLE
Adoption of an Emergency Ordinance Amending Palo Alto Municipal Code (PAMC) Chapter 16.04 to Add Local Administrative Amendments Related to Certificates of Occupancy and Definitions to the 2022 California Building Code, and an Emergency Ordinance Amending PAMC Chapter 16.17 to Adopt the 2025 California Energy Code and Local Amendments Thereto. CEQA Status – Exempt Under CEQA Guidelines Section 15061(b)(3) and 15308.

RECOMMENDATION
Staff recommends that the City Council:

1. Adopt, by a four-fifths majority, the attached emergency ordinance (Attachment E) to incorporate administrative amendments into Palo Alto Municipal Code 16.04, which implements the California Building Code, and
2. Adopt, by a four-fifths majority, the attached emergency ordinance (Attachment F) amending PAMC Chapter 16.17 to incorporate the 2025 Edition of the California Energy Code with local amendments related to energy efficiency.

EXECUTIVE SUMMARY
Staff requests Council consideration of two emergency amendments to the California Building Standards Code (CBSC) in response to new state law, ahead of the scheduled October triennial update. The first amendment addresses definitions and certificate of occupancy requirements, while the second introduces new energy reach codes for single-family homes, focusing on air conditioning unit replacement and FlexPath requirements for major remodels.

The CBSC (CCR, Title 24) is updated every three years, and local jurisdictions may adopt it as published or with more stringent amendments. The City has historically adopted stronger Energy and Green Building standards to promote sustainable, low-emissions construction.

AB 130 (2025) restricts local amendments to residential building standards after October 1, 2025, unless certain exemptions apply. The proposed administrative amendments to the City's 2022 building code must be adopted before September 30 to remain eligible for renewal, while

early adoption of energy reach codes is recommended to strengthen climate resilience. Additional climate-related amendments will be brought forward in October when model code language becomes available, and other amendments related to new construction will be considered in 2026 following completion of statewide cost-effectiveness studies.

BACKGROUND

Every three years, California updates its Building Standards Code, known as Title 24, to incorporate the latest technology, best practices, and policy goals for safe, efficient, and sustainable buildings. Title 24 includes requirements for building safety, energy efficiency, and green building practices. The California Green Building Standards Code (CALGreen) sets the statewide baseline for sustainable design, such as water efficiency and waste reduction, while the California Energy Code establishes minimum energy efficiency standards for insulation, heating and cooling systems, lighting, and solar. The Energy Code increasingly uses metrics such as "source energy" to account for the total fossil fuels and other resources consumed in supplying energy to a building.

State law requires that local amendments to the Energy Code be both energy-saving and cost-effective relative to the base codes. To make these findings, the City relies on cost-effectiveness studies, generally performed by the California Energy Codes and Standards Statewide Utility Program working group, which provide the technical basis to justify higher standards. Using these studies, local governments may adopt "reach codes," ordinances that exceed the state's minimum requirements, to meet community-specific sustainability and energy goals.

The City of Palo Alto updates its building codes every three years in alignment with the state's code cycle and often adopts local amendments that go beyond state minimum requirements. In 2008, Palo Alto established its first Energy Reach Code, and since then has regularly expanded its local green building and energy reach codes to advance climate action priorities, including those in the Sustainability and Climate Action Plan (S/CAP). The proposed amendments for the 2026–2028 Building Standards Code Cycle continue this approach and are detailed later in this report.

Timing Considerations

In most code cycles, local amendments to the Energy Code for single-family, multi-family, and non-residential building types are adopted together and take effect on January 1 of the first year of the cycle. For the upcoming 2026–2028 cycle, however, two factors will alter the timing and sequencing of some amendments.

First, the California Legislature passed AB 130 in June 2025, limiting the ability of local jurisdictions to adopt most new local amendments to Title 24 building standards affecting residential units after October 1, 2025. To ensure these proposals can be considered by the City Council before that deadline, staff is advancing the single-family Energy Reach Code recommendations now.

Second, reach codes for all residential building types cannot yet be proposed because Energy Code amendments depend on the completion of cost-effectiveness studies. These studies, typically completed by June of the year before the code cycle, are essential for justifying standards that exceed the state minimum. This year, the studies for multi-family residential and non-residential new construction have been delayed until late 2025 or early 2026, preventing staff from developing multi-family reach code proposals in time for the AB 130 deadline.

As a result, any new reach codes for multi-family residential new construction will likely need to be adopted after October 1, 2025, using one of AB 130's exemptions. The non-residential provisions are not subject to AB 130's moratorium. This staged approach is intended to keep Palo Alto aligned with the state's triennial code updates while advancing local amendments that reflect the City's sustainability priorities and climate action goals.

Phased Implementation Strategy

To address both the timing constraints created by AB 130 and the City's long-term sustainability objectives, staff recommends the following phased approach for adopting California Building Standards and local code amendments:

- **September 2025:** Adopt select local amendments to the 2022 California Building Code, effective immediately, and 2025 California Energy Code, effective January 1, 2026.
- **October 2025:** Propose adoption of the remaining parts of the 2025 California Building Standards Code, including re-adoption of currently active reach code amendments, also effective January 1, 2026.
- **Spring 2026:** Propose additional local amendments to the new construction Energy Code for all building types, with an effective date of July 1, 2026, pending completion of cost-effectiveness studies to support potential changes.

Proposed September 2025 Urgency Ordinance Amendments

This item includes adoption of two separate emergency ordinances:

1. **Administrative Amendments to PAMC Chapter 16.04**: These targeted changes, which clarify certificate of occupancy requirements and applicability of certain definitions, are intended to improve clarity and streamline code application. Although administrative in nature, they are subject to AB 130's moratorium on new amendments to Title 24 provisions that apply to residential units, and must be adopted prior to October 1, 2025 to remain enforceable without restriction. Adoption as an urgency ordinance would allow them to take effect immediately and later serve as the basis for renewed local amendments under AB 130's exemptions.
2. **Local Amendments to the California Energy Reach Code for Single-Family Homes, Duplexes, and Townhomes:** These proposals, supported by cost-effectiveness analysis, include:

- **Air Conditioner Time-of-Replacement Requirement** – Requires specified energy efficiency measures or installation of a heat pump system as the primary heating source when replacing or installing an air conditioner. Exceptions are provided for electrical panel limitations or oversized heating needs.
- **FlexPath for Major Remodels** – Requires additions or alterations over 1,000 square feet to incorporate a flexible package of efficiency or electrification upgrades selected from an approved menu of measures, allowing for customization based on project scope and building characteristics.
- Together, these amendments are intended to reduce fossil fuel reliance, lower greenhouse gas emissions, and prepare homes for a more efficient, electric-ready future, while aligning with state requirements, advancing Palo Alto's climate action targets, and supporting timely adoption before AB 130's October 1, 2025 deadline. While adopting these amendments before October 1 (via an emergency ordinance) may allow the City to avoid the AB 130 moratorium, AB 130 is a new law and its interpretation is untested. City staff will be prepared to bring the energy reach code for re-adoption later on using exemptions to the moratorium if necessary.

Table 1 below provides an overview of the timeline for adoption of the proposed local reach code amendments.

Table 1. Local Code Amendment Timeline

Table 1: Local Code Amendment Timeline		
Adoption Date	***Local Code Amendments***	
	Green Building Reach Code	***Energy Reach Code***
September 2025	• None	• Air Conditioner Time of Replacement • FlexPath
October 2025	• Carry forward previous local Green Building Code amendments[1] (including CALGreen Tier 1 & 2 adoption) • LEED Certification Alternative Compliance Pathway • Embodied Carbon Threshold • EV Readiness	• Carry forward previous local Energy Code amendments, as supported by cost effectiveness studies
Spring 2026	• None	• Potential additional Energy Code amendments as supported by newly available cost effectiveness studies and model

[1] More detail provided in Attachment A

Table 1: Local Code Amendment Timeline		
Adoption Date	***Local Code Amendments***	
	Green Building Reach Code	***Energy Reach Code***
		code language. E.g., Gas Water Heater Time of Replacement

ANALYSIS

Administrative Amendments to PAMC Chapter 16.04

PAMC Chapter 16.04 implements the California Building Code within the City. Staff are proposing targeted amendments to improve the code's clarity. The proposed changes include:

- **Certificate of Occupancy Requirements** – Clearly establishing which types of buildings or occupancies must obtain a certificate of occupancy prior to use.
- **Definitions** – Clarifying applicability of certain definitions.

These amendments refine both the administrative and technical provisions of the adopted codes that fall within the City's local authority. Adoption prior to AB 130's October 1, 2025 deadline is intended to keep these provisions enforceable without restriction. Staff recommends the Council adopt an ordinance codifying these changes, which staff will promptly file with the California Building Standards Commission. By adopting the ordinance as an emergency ordinance, Council intends the changes to take effect before AB 130's October 1, 2025 deadline, allowing the City to renew these local amendments in the future.

Local Amendments to the California Energy Reach Code for Single-Family Homes, Duplexes, and Townhomes

Potential Energy Code local amendments require cost-effectiveness studies before they can be adopted. They must be more stringent than the California Energy Code, generally using the metrics established by that code (such as source energy). At this time, staff are proposing two different types of energy code amendments that are supported by the appropriate cost-effectiveness studies:

- Time of replacement requirements for air conditioners that would require either energy efficiency measures or installation of heat pumps when equipment is replaced.
- Time of remodel requirements that would require a flexible combination energy efficiency or electrification measures known as "FlexPath".

AC to Heat Pump Time of Replacement Requirement

The proposed ordinance would require that projects in single-family homes, duplexes and townhomes involving replacement or alteration of an existing air conditioning system or installation of a new air conditioning system must either include a heat pump space conditioner

as the primary heating system or install specific energy efficiency measures. The attached study commissioned by the California Codes and Standard Program (see Attachment B) has found that the proposed requirements are cost-effective and will result in a reduction in Long-Term System Cost (LSC)[2] energy. Heat pumps are far more efficient than gas furnaces and result in fewer greenhouse gas emissions.

If a project applicant installed a heat pump (an air conditioner that is also configured to function as a space heater) they could either replace the furnace with an air handler unit or leave the furnace in place to serve as the air handler for the heat pump and as a back-up heating system. California Energy Code requirements would apply; these vary depending upon whether the duct system is replaced at the same time.

Alternatively, a project could comply by installing an air conditioner but relying on a gas furnace for space heating. Again, certain California Energy Code requirements would apply when replacing an air conditioner. In addition, this alternative would require other energy efficiency measures including attic insulation and air sealing.

Table 2 presents four different compliance paths. Note that additional requirements would apply where the air conditioner is not configured as a heat pump space conditioner.

Table 2: Summary of Requirements

System	*Ducts Condition*	*State Code Requirements*	*Additional Local Code Requirements*
Heat Pump	Existing	• Duct sealing (10% leakage) • Airflow efficiency (300 CFM/ton) • Refrigerant charge verification	• None
	New	• Duct sealing (5% leakage) • Airflow efficiency (350 CFM/ton) • Fan efficacy (0.58 W/CFM) • Refrigerant charge verification • Attic insulation (R-49) • Air sealing • R-8 Duct insulation	• None
AC	Existing	• Duct sealing (10% leakage) • Airflow efficiency (300 CFM/ton)	• Refrigerant charge verification • Fan efficacy (0.45 watts/CFM) • Attic insulation (R-49) • Air sealing
	New	• Duct sealing (5% leakage)	• Refrigerant charge verification

[2] Formerly known as Time Dependent Valuation (TDV) energy cost savings, LSC reflects the Energy Commission's current LCC methodology, which is intended to capture the total value or cost of energy use over 30 years. This method accounts for the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade-based CO2 emissions (California Energy Commission, 2023). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in the 2025 Energy Code.

Table 2: Summary of Requirements			
System	***Ducts Condition***	***State Code Requirements***	***Additional Local Code Requirements***
		• Airflow efficiency (350 CFM/ton) • Fan efficacy (0.45 W/CFM) • Attic Insulation (R-49) • Air sealing • R-8 Duct insulation	• Fan efficacy (0.35 watts/CFM)

The 2025 Single Family AC to HP Cost Effectiveness Study attached as Attachment B finds some incremental costs associated with converting to a heat pump, but these costs can be offset by utility bill savings over the lifetime of the equipment. The lifetime of a furnace and air conditioner are about the same, so it often makes economic sense to replace both if the furnace is near the end of its life. In this scenario, the cost of the furnace replacement is assumed as part of the base project cost. Alternatively, a heat pump could be configured to operate as the primary heating source using the air handler in the existing furnace and using the furnace for supplemental heating on very cold days. Table 3 below compares the incremental cost and lifecycle savings (net present value of utility bill savings less incremental cost) for each approach assuming a modest gas rate escalation.

Table 3. Economic Costs and Savings		
Approach	***Incremental Cost***	***Lifecycle Savings***
Heat pump with new air handler (furnace removed)	$652	$556
Heat pump with existing furnace retained	$1,670	$2,132

The costs may be able to be further offset by incentives offered through local utility rebate programs, depending on whether these are retained after the mandate takes effect.

In terms of greenhouse gas emissions, heat pumps can provide significant reductions. This is because heat pumps are far more efficient than gas furnaces (and electric resistance heat) and electricity in California is derived from low-carbon energy sources. Table 4 shows greenhouse gas reductions for both approaches generated using the statewide Cost Effectiveness Explorer tool.

Table 4. Greenhouse Gas Reductions			
Climate Zone	***Approach***	***GHG Reduction (tons annually)***	***GHG Reductions (%)***
CZ04	Heat pump & new air handler (furnace removed)	0.84	30%
CZ04	Heat pump with existing furnace retained	0.63	22%

The proposed policy offers two general exceptions. The first is for situations where the electrical panel capacity is insufficient to meet the load of a heat pump. The second is where the heat pump would need to be sized more than 12,000 Btu/hr (1 ton) over the air conditioner

that would be installed. There are also exceptions to the duct sealing and airflow requirements that specify alternative methods of compliance. All applicable exceptions in the California Energy Code apply.

The statewide cost-effectiveness study for the air conditioner time of replacement requirements is included in Attachment B. Staff is recommending adoption at this time of a replacement requirement to be effective starting on January 1, 2027, allowing more time to launch and run programs to support heat pump HVAC adoption.

FlexPath

Staff proposes that single-family residential major additions and alterations[3] greater than 1,000 square feet be required to include certain energy efficiency measures. Depending on the project scope, applicants of these types of projects typically already have an architect, engineer, and energy code compliance expert on their design team who can help facilitate compliance with the FlexPath energy code amendment. As proposed, qualifying single-family projects would be required to complete any combination of energy-related measures from Table 5 below totaling 12 or more points. Additional measure descriptions can be found in Attachment C.

Table 5. Measures

Measures	***Building Vintage***		
	Pre-1978	***1978-1991***	***1992-2010***
Water Heating Package	1	1	1
Air Sealing	2	1	1
R-38 Attic Insulation	7	3	1
R-49 Attic Insulation	7	3	1
Duct Sealing	6	4	1
New Ducts, R-6 Insulation + Duct Sealing	10	7	2
New Ducts, R-8 Insulation + Duct Sealing	11	8	3
Windows	6	5	3
Wall Insulation	6	-	-
R-19 Raised floor insulation	8	8	-
R-30 Raised floor insulation	9	9	-
Radiant Barrier Under Roof	3	2	1
Heat Pump Water Heater Replacing Gas	12	12	12
High Eff. Heat Pump Water Heater Replacing Gas	13	13	13

[3] Alterations include raising the plate height, historic restoration, changes or rearrangements of the structural parts or elements, and changes or rearrangement of bearing walls and full height partitions. Normal maintenance, reroofing, painting or wall papering, floor finishes, replacement-in-kind of mechanical, plumbing and electrical systems, or replacing or adding new kitchen counter and similar furniture, plumbing fixture to the building are excluded

Table 5. Measures			
Measures	***Building Vintage***		
	Pre-1978	***1978-1991***	***1992-2010***
Heat Pump Water Heater Replacing Electric	4	4	4
High Eff. Heat Pump Water Heater Replacing Electric	5	5	5
Heat Pump Space Conditioning System	21	16	13
High Eff. Heat Pump Space Conditioning System	23	18	15
Dual Fuel Heat Pump Space Conditioning System	15	11	10
Heat Pump Clothes Dryer	1	1	1
Induction Cooktop	1	1	1
Solar PV	17	17	15

To accommodate the wide variability in existing buildings, staff proposes the following exemptions (the list below provides a brief overview of exemptions which are described in greater detail in Attachment F):

New Units

1. Mobile Homes, Manufactured Housing, or Factory-built Housing
2. Repairs
3. Emergency Housing
4. Technological or Economic Infeasibility
5. Energy usage of alternative proposed design better than requirement
6. Pre-Compliance
7. Covenant Restrictions
8. New Construction
9. Improvement projects limited to solar PV, EV charging, or battery storage
10. Hardship for Low-Income Owners
11. Historic Buildings
12. Hazard Mitigation (i.e. Seismic upgrades)
13. Alterations that consist solely of roof and/or window projects
14. State-exempted ADUs per SB1211

The CEC provides two different cost effectiveness metrics. “On-bill” cost effectiveness refers to the direct cost experienced by the homeowner. For something to be cost effective “on-bill”, the energy bill savings of a measure must at least pay for the cost of that measure over a 20-year period. The other approach is “Long-Term Systemwide Cost” (LSC). LSC considers the cost to install energy efficiency measures, the on-bill savings from those measures, and larger system costs that everyone pays for like energy infrastructure costs and the impacts of climate change. For CEC approval, a local amendment to the California Energy Code must show a compliance pathway that is either “on-bill” or “LSC” cost effective. As described below, staff’s proposed policy has “on-bill” and “LSC” cost effective compliance pathways.

In support of reach code development, the California Energy Codes and Standards Statewide Utility Program, which includes the State's Investor-Owned Utilities (Pacific Gas, and Electric (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE), under the auspices of the California Public Utilities Commission) developed and published the 2025 Single Family Cost Effectiveness Report, provided as Attachment C and further supported by an updated memo provided as Attachment D. This study and the associated cost-effectiveness data are highly detailed and are included in the record to support Council's findings and policy decisions.

Based on the study, staff recommends finding the proposed local additions and alterations amendments to the 2025 California Energy Code to be cost-effective and consume less energy than otherwise permitted by Title 24, Part 6. The target score of 12 points can be achieved cost-effectively for all building vintages through the installation of a heat pump water heater or heat pump space conditioner replacing a corresponding gas appliance. The 12-point target can also be met only through the installation of energy efficiency improvements without the need for fuel-substitution measures. For example, R-30 raised floor insulation combined with R-49 attic insulation in any pre-1991 building. Estimates of the incremental costs and lifecycle savings associated with FlexPath compliance pathways mentioned above are included in Table 6. Each unique combination of measures and building vintages will have its own associated costs and savings. Additional measure information, including incremental cost estimates, is available through a Cost-Effectiveness Explorer[4] tool published by the California Energy Codes and Standards Statewide Utility Program working group.

Table 6. FlexPath Compliance Pathway Costs and Savings

Measures	***Incremental Cost***	***Lifecycle Savings***
Heat pump water heater	$4,332	$5,358
R-30 raised floor insulation + R-49 attic insulation	$7,725	$14,403

FISCAL/RESOURCE IMPACT

Development and implementation of local amendments to the 2026-2028 State Energy and Green Building Standards Codes is planned to be absorbed within existing budgets for Planning and Development Services and Utilities. Resource needs are anticipated to include about 0.5 FTE in staff time and $248,000 in professional services costs spread across FY 2025 and FY 2026. Resource needs are under continued evaluation and may result in an additional funding request if deemed necessary.

[4] Cost Effectiveness Explorer; https://explorer.localenergycodes.com/policies/4287/requirements?per_component_name=PolicyExistingBuildingsWithFlexiblePathRequirements&per_climate_zone_raw=4-CPAU&per_custom_combination_id=22972

STAKEHOLDER ENGAGEMENT

Staff hosted two community meetings on the Building Standards Code update. The first, a focus group with approximately 10 design professionals, was held on August 12, 2025. The second, a hybrid community meeting on August 13, 2025, drew 13 attendees. Meetings were advertised via the City website, Uplift Local newsletter, City calendar, NextDoor, Facebook, and targeted email notices to approximately 100 community members and design professionals.

Feedback covered all 2025 proposals, including Green Building Code amendments scheduled for Council review in October. Key themes included:

- FlexPath: Stakeholders suggested adding/removing measures or adjusting point values. Staff explained changes would require new cost-effectives studies and could be considered in the future.
- Water Heaters: Questions focused on alignment with Bay Area Air District Zero-NOx standards (2027). Staff expects statewide model code language will incorporate exemptions. A request to allow electric resistance water heaters in ADUs was discussed; staff noted this option is inefficient and rarely complaint under state Energy Code.
- Water Conservation: Suggestions were made to add elective CALGreen Tier 1 and 2 measures (e.g., toilet efficiency). Staff clarified these are already permissible under "innovative concepts" and will improve applicant guidance.
- Other Suggestions: Additional future considerations included requiring electric stoves at replacement, regulating gas appliances under air quality authority, adopting passive house standards, adjusting EV readiness requirements, and updating electric load calculations.

Staff is reviewing these suggestions for possible inclusion in October local amendments or in future round of amendments.

ENVIRONMENTAL REVIEW

The recommended action in this report is exempt from the California Environmental Quality Act (CEQA) in accordance with CEQA Guidelines section 15308 as an action by the City for the protection of the environment, and under section 15061(b)(3) on the grounds that the proposed standards are more stringent than the State standards, there are no reasonably foreseeable adverse environmental impacts and there is no possibility that the activity in question may have a significant adverse effect on the environment.

ATTACHMENTS

Attachment A: GBC Applicability and Existing Reach Code Amendments

Attachment B: 2025 Cost-Effectiveness Study: Single Family AC to Heat Pump Replacement

Attachment C: 2022 Cost - Effectiveness Study: Existing Single Family Building Upgrades

Attachment D: Application of the 2022 Studies to the 2025 Energy Code: Existing Single Family Building Upgrades

Attachment E: Emergency Ordinance Amending PAMC Chapter 16.04 to Adopt Administrative Amendments to the 2022 California Building Code

Attachment F: Emergency Ordinance Amending PAMC Chapter 16.17 to Adopt the 2025 California Energy Code and Local Amendments, Adding FlexPath and Air Conditioner Time-of-Replacement Requirement

APPROVED BY:

Jonathan Lait, Planning and Development Services Director

Green Building Code Applicability Requirements and Existing Local Amendments

Single Family CalGreen Code Applicability

Scope of Work	Current requirements
ADU conversions, alterations, additions	CalGreen Mandatory
Alterations / Additions that Increase conditioned area and do not trigger Tier 1 requirements	CalGreen Mandatory
Additions / Alterations[1] >1000 sf	CalGreen Mandatory + Tier 1
New construction or substantial remodel	CalGreen Mandatory + Tier 2

Multi-Family CalGreen Code Applicability

Scope of Work	Current requirements
Alterations / Additions that Increase conditioned area and do not trigger Tier 1 requirements	CalGreen Mandatory
Additions / Alterations[1] >1000 sf	CalGreen Mandatory + Tier 1
New construction or substantial remodel	CalGreen Mandatory + Tier 2

Non-Residential CalGreen Code Applicability

Scope of Work	Current requirements
Tenant Improvements (Tis), Renovations, Alterations w/ $200,000 permit valuation and do not trigger Tier 1 or Tier 2 requirements	CalGreen Mandatory
TIs, Renovations, Alterations > 5,000 SF w/ replacement of two systems: HVAC system, building envelope, hot water system, lighting system	CalGreen Mandatory + Tier 1
Additions > 1,000 SF	CALGreen Mandatory + Tier 2
New construction	CalGreen Mandatory + Tier 2

[1] Alterations include raising the plate height, historic restoration, changes or rearrangements of the structural parts or elements, and changes or rearrangement of bearing walls and full height partitions. Normal maintenance, reroofing, painting or wall papering, floor finishes, replacement-in-kind of mechanical, plumbing and electrical systems, or replacing or adding new kitchen counter and similar furniture, plumbing fixture to the building are excluded for the purposes of establishing scope of Tier 1 projects (PAMC 16.14.080).

Existing Local Amendments to the Green Building Code

	Applies To:		
	Single Family	Multi Family	Non Res
Third-party Green Building Special Inspector required for all projects (PAMC 16.14.080)	X	X	X
Low-carbon concrete requirements for Tier 1 and Tier 2 projects (PAMC 16.14.080, PAMC 16.14.240)	X	X	X
Deconstruction and construction materials management (PAMC 16.14.150, PAMC 5.24)	X	X	X
Cement and concrete made with recycled products (PAMC 16.14.420)			X
Enhanced construction waste reduction of 80%	X	X	X
Local storm water pollution prevention for new construction and additions (PAMC 16.14.290)			X
Invasive species prohibited (PAMC 16.14.330)			X
Indoor Air Quality Management Plan (PAMC 16.14.390)		X	X
Recycled water infrastructure for irrigation		X	X
Cooling tower water use		X	X
Swimming pool and spa covers – vapor retardant cover required (PAMC 16.14.100)	X	X	
Non-residential enhanced water budget (PAMC 16.14.340)			X
Energy STAR portfolio manager profile for energy and water use, energy and water performance reviews (PAMC 16.14.360, 370, 380)			X
Full electrification of outdoor grills, stoves, and barbeques (PAMC 16.14.090)	X	X	X
Electric readiness requirements (PAMC 16.14.190/410, PAMC 16.17)	X	X	X
Enhanced EV Charging requirements (PAMC 16.14.160, PAMC 16.14.400)	X	X	X

Summary of Enhanced EV Charging Requirements in the Green Building Code

For clarity, the table below summarizes the EV charging requirements in the Green Building Code at a high level and are accurate for most projects. For precise requirements see PAMC 16.14.160 and 16.14.400.

	Single Family	**Multi-family**	**Hotels/Motels**	**Nonresidential**
New Construction of Any Size (including substantial remodel for residential)	Install 1 EV Ready Space OR Install 1 Level 2 EV Charger *Exception: Accessory Dwelling Unit (ADU)*	Resident Parking: For each residential unit, install one Level 2 EV Charger OR Install one Level 2 EV Ready Space for each residential unit AND Guest Parking: 25% EV Capable, EV Ready, EV Chargers AND 10% EV Chargers Installed	40% EV Ready AND 10% Level 2 EV Chargers Installed	10 to 20 parking spaces: 20% EV Capable or EV Ready Space AND 20% Level 2 EV Chargers Installed OR Over 20 parking spaces: 15% EV Capable or EV Ready Space AND 15% EV Chargers Installed

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2025 Cost-Effectiveness Study: Single Family AC to Heat Pump Replacement

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SDGE
SOUTHERN CALIFORNIA EDISON Energy for What's Ahead
Pacific Gas and Electric Company

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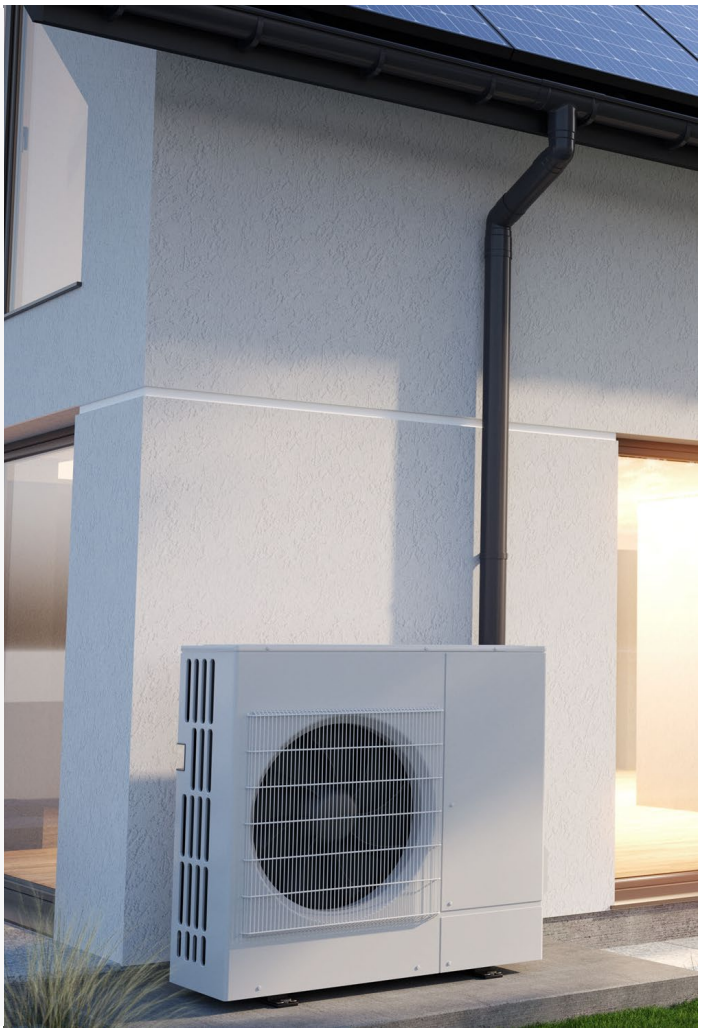

Table 1. Summary of Revisions

Date	Description	Reference (page or section)
6/09/2025	Original Release	N/A

Acronym List

AC – Air conditioner

ACH50 – Air Changes per Hour at 50 pascals pressure differential

AFUE – Annual Fuel Utilization Efficiency

B/C – Lifecycle Benefit-to-Cost Ratio

BSC – Building Standards Commission

CA IOUs – California Investor-Owned Utilities

CARE – California Alternate Rates for Energy

CASE – Codes and Standards Enhancement

CBECC-Res – Computer program developed by the California Energy Commission for demonstrating compliance with the California Residential Building Energy Efficiency Standards

CFM – Cubic Feet per Minute

CO_2 – Carbon Dioxide

CPAU – City of Palo Alto Utilities

CPUC – California Public Utilities Commission

CZ – California Climate Zone

DFHP – Dual Fuel Heat Pump

DHW – Domestic Hot Water

DOE – Department of Energy

EDR – Energy Design Rating

EER – Energy Efficiency Ratio

EF – Energy Factor

GHG – Greenhouse Gas

HPWH – Heat Pump Water Heater

HSPF – Heating Seasonal Performance Factor

HVAC – Heating, Ventilation, and Air Conditioning

IOU – Investor Owned Utility

kBtu – kilo-British thermal unit

kWh – Kilowatt Hour

LCC – Lifecycle Cost

LLAHU – Low Leakage Air Handler Unit

VLLDCS – Verified Low Leakage Ducts in Conditioned Space

NEEA – Northwest Energy Efficiency Alliance

NEM – Net Energy Metering

NPV – Net Present Value

PG&E – Pacific Gas and Electric Company

PV – Photovoltaic

SCE – Southern California Edison

SDG&E – San Diego Gas and Electric

SEER – Seasonal Energy Efficiency Ratio

SF – Single Family

SMUD – Sacramento Municipal Utility District

SoCalGas – Southern California Gas Company

TDV – Time Dependent Valuation

Therm – Unit for quantity of heat that equals 100,000 British thermal units

Title 24 – Title 24, Part 6

TOU – Time-Of-Use

UEF – Uniform Energy Factor

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Executive Summary

The California Codes and Standards (C&S) Reach Codes program, also known as the Local Energy Codes program, provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy efficiency and greenhouse gas (GHG) reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

It is important to note that there is a voluntary measure in the 2025 CALGreen for replacing an air conditioner with a heat pump at time of air conditioner replacement, which can be adopted as is. This report seeks to provide options to modify the heat pump measure, and demonstrate the cost-effectiveness of these options.

This analysis used two different metrics to assess the cost-effectiveness of the proposed upgrades for a 1,665 square foot single family home prototype with an attached garage. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with each energy efficiency measure over a 30-year analysis period. On-Bill cost-effectiveness is an occupant-based lifecycle cost (LCC) approach that values energy based upon estimated site energy usage and customer utility bill savings using today's electricity and natural gas utility tariffs. To reflect how natural gas prices fluctuate with seasonal supply and demand, a normalized curve was used to estimate the cost for the remaining months relative to today's rates. Long-term Systemwide Cost (LSC) is the California Energy Commission's metric for determining cost-effectiveness of efficiency measures in the 2025 Energy Code. This metric is intended to capture the long-term projected cost of energy including costs for providing energy during peak periods of demand, carbon emissions, grid transmission and distribution impacts.

Local jurisdictions may adopt ordinances that amend different parts of the California Building Standards Code or may elect to amend other state or municipal codes. The decision regarding which code to amend will determine the specific requirements that must be followed for an ordinance to be legally enforceable. For example, reach codes that amend Part 6 of the California Building Code (the Energy Code) and require energy performance beyond state code minimums must demonstrate the proposed changes are cost-effective and obtain approval from the Energy Commission as well as the Building Standards Commission (BSC). Amendments to Part 11, such as requirements for increased water efficiency or electric vehicle infrastructure only require BSC approval and do not require the Energy Commission approval. Although a cost-effectiveness study is only required to amend Part 6 of the California Building Code, this study provides valuable context for jurisdictions pursuing other ordinance paths to understand the economic impacts of the policy decision. This study documents the estimated costs, benefits, energy impacts and greenhouse gas emission reductions that may result from implementing an ordinance based on the results to help residents, local leadership, and other stakeholders make informed policy decisions.

The following summarizes key results:

1. Heat pumps are significantly more efficient than gas furnaces, requiring less than half the energy to meet the heating load. However, despite this reduction in heating energy use, the cost of heating a home using electricity (heat pump) could be higher than the cost to heat that same home with natural gas (furnace), depending on the electricity tariffs relative to the gas tariffs. Therefore, while a heat pump measure could be deemed as cost-effective over its lifecycle, installing a heat pump could result in a decrease *or* an increase in utility costs in the first years relative to a gas furnace and AC system.
2. The study assumes utility rates escalate over time. Because it is very difficult to predict how the rates will change, the analysis presents two escalation scenarios (modest and high gas escalation) to represent a range of outcomes.
3. The LSC metric most often produces more favorable cost-effectiveness results relative to the results produced using actual utility costs (On-Bill). When the analysis assumes a higher escalation rate for natural gas costs relative to electricity in future years (high gas escalation), the On-Bill results are more favorable in some cases.
    a. In the oldest (pre-1978) vintage, all three measures (dual fuel heat pump with existing furnace, standard heat pump space heater, and high efficiency heat pump space heater) are cost-effective using the LSC metric in all climate zones. When using the On-Bill metric, the measures remain cost-effective in most climate zones.
    b. In the newer (1978-1991 and 1992-2010) vintages, the dual fuel heat pump (DFHP Existing Furnace) and the standard efficiency HPSH are cost-effective based on LSC in all cases except for Climate Zone 15 when using both the standard and California Alternate Rates for Energy (CARE) tariff.
4. Using the CARE tariff results in higher cost savings and cost-effectiveness relative to standard rates, with almost all cases yielding first year utility cost savings. The DFHP Existing Furnace is On-Bill cost-effective based on the high gas escalation scenario in all cases in the pre-1978 vintage, and almost all cases in the 1978-1991 and 1992-2010 vintage. It is also On-Bill cost-effective in most climate zones for the modest gas escalation scenario across all vintages. In Climate Zones 5, 8, 9, 10, 14, and 15, cost-effectiveness declines relative to other areas, and in some cases is not cost-effective from an On-Bill perspective. This is the case for both the CARE tariff and the standard rate.
5. The analysis also modeled the cost impact of using a standard time-of-use electricity tariff versus switching to a newer electrification tariff, designed to reduce costs in homes with heat pumps and/or electric vehicles. Older homes tend to be the least efficient and achieve the most savings from improving equipment efficiency. In most of the state, because older homes tend to use more electricity than a similarly sized, newer vintage home, they realize more costs savings under the electrification tariff. Newer homes tend to use less electricity and therefore do not realize the same cost

savings from switching tariffs; they generally perform better under the standard tariff. This trend is different in milder climate zones in SCE territory (excluding CZ 15), where newer homes realize more cost savings. Both the standard and electrification tariffs in SCE territory include a daily allocation of lower-cost baseline electricity and a second, higher-priced tier when the baseline is exceeded. In many newer homes, a higher percentage of overall electricity use is within the baseline allocation, resulting in greater cost savings.

6. Higher efficiency equipment reduces utility costs in all cases and improves cost-effectiveness in many climate zones in the oldest vintage relative to standard efficiency equipment. However, in more efficient newer homes, where cost-effectiveness is generally lower, the savings are insufficient to offset the roughly $3,000 increase in incremental cost.
7. Given the adopted Bay Area Air Quality Management District (BAAD) Zero NOx rule, and the proposed California Air Resource Board or South Coast Air Quality Management District (SCAQMD) Zero-NOx rules, and gas furnaces are no longer available or less available to be installed in 2030, a sensitivity analysis was performed for the Zero NOx scenario and found that cost-effectiveness declines in many cases except in Climate Zones 8-10, some results improve enough to become cost-effective. The improved cost-effectiveness in Climate Zones 8-10 is due to the higher baseline cost when a HPSH must be installed at year 10 when the furnace must be replaced. However, the overall magnitude of 30-year On-Bill cost-effectiveness is lower because there are only 10 years of utility cost savings. After year 10 the base case and upgrade measures are both heat pumps.

This report documents the key results and conclusions from the Reach Codes Team analysis. A full dataset of all results can be downloaded at https://localenergycodes.com/content/resources. Results alongside policy options can also be explored using the Cost-effectiveness Explorer at https://explorer.localenergycodes.com/. Model ordinance language and other resources are posted on the C&S Reach Codes Program website at LocalEnergyCodes.com. Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at info@localenergycodes.com.

1 Introduction

The California Codes and Standards Reach Codes program, also known as the Local Energy Codes program, provides technical support to local governments considering adopting a local ordinance intended to support meeting local and/or statewide energy efficiency and greenhouse gas (GHG) reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

Local jurisdictions may adopt ordinances that amend different parts of the California Building Standards Code or may elect to amend other state or municipal codes. The decision regarding which code to amend will determine the specific requirements that must be followed for an ordinance to be legally enforceable. For example, reach codes that amend Part 6 of the California Building Code (the Energy Code) (CEC, 2025) and require energy performance beyond state code minimums must demonstrate the proposed changes are cost-effective and obtain approval from the Energy Commission as well as the Building Standards Commission (BSC). Amendments to Part 11, such as requirements for increased water efficiency or electric vehicle infrastructure only require BSC approval and do not require the Energy Commission approval. Although a cost-effectiveness study is only required to amend Part 6 of the California Building Code, this study provides valuable context for jurisdictions pursuing other ordinance paths to understand the economic impacts of the policy decision. This study documents the estimated costs, benefits, energy impacts and greenhouse gas emission reductions that may result from implementing an ordinance based on the results to help residents, local leadership, and other stakeholders make informed policy decisions.

This report is an update to the *2022 Single Family Retrofit Cost-effectiveness Study* (Statewide Reach Codes Team, 2024) focused on an ordinance structure that encourages air conditioner (AC) to heat pump replacement. The methodology, prototype characteristics, and relevant measure packages are retained from the main study referenced above. The study includes updated utility rates, revised costs based on the TECH Clean California[1] incremental cost study data, estimated costs for the AC path, updated and expanded AC path options, and a new cost-effectiveness scenario that considers upcoming proposed zero-NOx emission regulations (SCAQMD, 2025) (California Air Resources Board, 2022) (BAAD, 2025).

Local jurisdictions in California may consider adopting local energy ordinances to achieve energy savings beyond what will be accomplished by enforcing building efficiency requirements that apply statewide.

Local jurisdictions may also adopt ordinances that amend different parts of the California Building Standards Code or may elect to amend other state or municipal codes. The

[1] https://techcleanca.com/

decision regarding which code to amend will determine the specific requirements that must be followed for an ordinance to be legally enforceable. Although a cost-effectiveness study is only required to amend Part 6 of the CA Building Code, it is important to understand the economic impacts of any policy decision. This study documents the estimated costs, benefits, energy impacts and greenhouse gas emission reductions that may result from implementing an ordinance based on the results to help local leadership, residents, and other stakeholders make informed policy decisions.

This report was developed in coordination with the California Statewide Investor-Owned Utilities (IOUs) Codes and Standards Program, the California Energy Commission (CEC), key consultants, and engaged cities—collectively known as the Statewide Reach Codes Team. Model ordinance language and other resources are posted on the C&S Reach Codes Program website at LocalEnergyCodes.com. Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at info@localenergycodes.com.

2 Methodology and Assumptions

This study evaluates a potential reach code that encourages a heat pump or dual fuel system that includes a heat pump combined with a furnace when an air conditioner is replaced or installed new in existing single family homes. The ordinance structure and this analysis is based on the voluntary requirements adopted in 2025 Title 24, Part 11 California Green Building Standards Code (CALGreen), Section A4.204.1.1 for heat pump space conditioning alterations in single family homes (California Energy Commission, 2025). The proposed reach code also defines pathways for air conditioning equipment to be installed combined with additional efficiency measures. The heat pump path requires the heat pump as the primary heat source, with backup heating allowable either provided by electric resistance or natural gas. In cases where the existing furnace remains, the heat pump is installed alongside the existing furnace with integrated controls to allow for the furnace to provide backup heating. In alignment with the 2025 Energy Code requirements the heat pump must be sized to satisfy the heating load at the design heating temperature without the use of backup heat.

All methodology and assumptions are consistent with prior statewide analysis (Statewide Reach Codes Team, 2024) with the following exceptions:

1. Updated utility rates to January 2025
2. Equipment costs based on TECH data where available; the original report was based on Statewide contractor survey costs
3. Cost estimates were obtained for the AC path
4. Expanded AC path options
5. Cost-effectiveness results for the scenario if gas furnaces are no longer available for sale in California in 2030

2.1 Modeling

The Reach Codes Team performed energy simulations using the 2025 research version of the Residential California Building Energy Code Compliance software (CBECC). The 2025 version of CBECC includes updated weather files, metrics, and the weather stations were changed in Climate Zones 4 and 6 from San Jose to Paso Robles and Torrance to Los Angeles International Airport, respectively. Note that at the time of this report, the Energy Commission was working on integrating a new heat pump model into the CBECC-Res software to better reflect the actual energy use of heat pumps. The updated model results in lower heating energy use than is currently estimated. Once the revised software is released, the reach codes team plans to update this analysis.

Three unique building vintages are included: pre-1978, 1978-1991, and 1992-2010. The vintages were defined based on review of historic building code requirements and defining periods with distinguishing features. The proposed measures were modeled to determine the projected site energy (therm and kWh), source energy, GHG emissions, and long-term systemwide cost (LSC) impacts. Annual utility costs were calculated using hourly data

output from CBECC, and updated (as of 1/1/2025) electricity and natural gas tariffs for each of the investor-owned utilities (IOUs) as appropriate for that climate zone.

Site energy results are similar between CBECC-Res 2022 and 2025. The 2025 compliance metrics include assumptions that more appliances will be electric in the future. This is predicted to result in higher natural gas retail rates as a result of gas utilities continuing to maintain safe and reliable infrastructure amidst declining natural gas use.

Equivalent CO_2 emission reductions were calculated based on outputs from the CBECC-Res simulation software. Electricity emissions vary by region and by hour of the year. CBECC-Res applies two distinct hourly profiles, one for Climate Zones 1 through 5 and 11 through 13 and another for Climate Zones 6 through 10 and 14 through 16. Natural gas emissions do not vary hourly. To compare the mixed-fuel and all-electric cases side-by-side, GHG emissions are presented as pounds of CO_2-equivalent (CO_2e) emissions.

The Statewide Reach Codes Team designed the approach and selected measures for evaluation based on the 2019 existing building single family reach code analysis (Statewide Reach Codes Team, 2021) and supporting analysis used in the 2025 Energy Code development cycle as well as from outreach to architects, builders, and engineers.

2.2 Prototype Characteristics

The Energy Commission defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Energy Code requirements. Average home size has steadily increased over time, and the Energy Commission single family new construction prototypes are larger than many existing single family homes across California. For this analysis, a 1,665 square foot prototype was evaluated. Table 2 describes the basic characteristics of the single family prototype. Additions are not evaluated in this analysis as they are already addressed in Section 150.2 of the Energy Code. In the 2025 Energy Code heat pumps are prescriptively required for space and water heating for additions (California Energy Commission, 2023).

Table 2. Residential Prototype Characteristics

Climate Zone	Specification
Existing Conditioned Floor Area	1,665 ft^2
Num. of Stories	1
Num. of Bedrooms	3
Window-to-Floor Area Ratio	13%
Attached Garage	2-car garage

Three building vintages were evaluated to determine sensitivity of existing building performance on cost-effectiveness of upgrades. For example, it is widely recognized that adding attic insulation in an older home with no insulation is cost-effective, however, newer homes will likely have existing attic insulation reducing the cost-effectiveness of an incremental addition of insulation. The building characteristics for each vintage were

determined based on either prescriptive requirements from the building code that were in effect or standard construction practice during that time period. For example, homes built under 2001 Title 24 are subject to prescriptive envelope code requirements very similar to homes built under the 2005 code cycle, which was in effect until January 1, 2010.

Table 3 summarizes the assumptions for each of the three vintages. Additionally, the analysis assumed the following features when modeling the prototype buildings.

- Efficiencies were defined by year of the most recent equipment replacement based on standard equipment lifetimes.
- Individual space conditioning and water heating systems, one per single family building.
- Split-system air conditioner with natural gas furnace.
- Gas cooktop, oven, and clothes dryer.

The methodology applied in the analyses begins with a design that matches the specifications as described in Table 3 for each of the three vintages. Heat pump space conditioning measures were modeled to determine the projected energy performance and utility cost impacts relative to the baseline vintage.

Table 3. Efficiency Characteristics for Three Vintage Cases

Building Component Efficiency Feature	Pre-1978 Vintage	1978-1991 Vintage	1992-2010 Vintage
Envelope			
Exterior Walls	2x4, 16-inch on center wood frame, R-0[2]	2x4 16 inch on center wood frame, R-11	2x4 16 inch on center wood frame, R-13
Foundation Type & Insulation	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-19 (CZ 1 & 16)
Ceiling Insulation & Attic Type	Vented attic, R-5 @ ceiling level for CZ 6 & 7, Vented attic, R-11 @ ceiling level (all other CZs)	Vented attic, R-19 @ ceiling level	Vented attic, R-30 @ ceiling level
Roofing Material & Color	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)
Radiant Barrier	No	No	No
Window Type: U-factor/SHGC[3]	Metal, single pane: 1.16/0.76	Metal, dual pane: 0.79/0.70	Vinyl, dual pane Low-E: 0.55/0.40
House Infiltration at 50 Pascals	15 ACH50	10 ACH50	7 ACH50
HVAC Equipment			
Heating Efficiency	78 AFUE (assumes 2 replacements)	78 AFUE (assumes 1 replacement)	78 AFUE
Cooling Efficiency	10 SEER (assumes 2 replacements)	10 SEER (assumes 1 replacement)	13 SEER, 11 EER
Duct Location & Details	Attic, R-2.1, 30% leakage at 25 Pa	Attic, R-2.1, 25% leakage at 25 Pa	Attic, R-4.2, 15% leakage at 25 Pa
Whole Building Mechanical Ventilation	None	None	None
Water Heating Equipment			
Water Heater Efficiency	0.575 Energy Factor (assumes 2 replacements)	0.575 Energy Factor (assumes 1 replacement)	0.575 Energy Factor
Water Heater Type	40-gallon gas storage	40-gallon gas storage	40-gallon gas storage
Pipe Insulation	None	None	None
Hot Water Fixtures	Standard, non-low flow	Standard, non-low flow	Standard, non-low flow

[2] Pre-1978 wall modeled with R-5 cavity insulation to better align wall system performance with monitored field data and not overestimate energy use.
[3] Window type selections were made based on conversations with window industry expert, Ken Nittler. If a technology was entering the market during the time period (e.g., Low-E during 1992-2010 or dual-pane during 1978-1991) that technology was included in the analysis. This provides a conservative assumption for overall building performance and additional measures may be cost-effective for buildings with lower performing windows, for example buildings with metal single pane windows in the 1978-1991 vintage

2.3 Cost-Effectiveness Approach

2.3.1 Benefits

This analysis used two different metrics to assess the cost-effectiveness of the proposed upgrades. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with each energy efficiency measure. The main difference between the methodologies is the way they value energy impacts:

- **On-Bill:** Customer-based lifecycle cost approach that values energy based upon estimated site energy usage and customer On-Bill savings using electricity and natural gas utility rate schedules over a 30-year duration, accounting for a three percent discount rate and energy cost inflation per Appendix 6.3.7.
- **Long-term Systemwide Cost (LSC):** Formerly known as Time Dependent Valuation (TDV) energy cost savings, LSC reflects the Energy Commission's current lifecycle cost (LCC) methodology, which is intended to capture the total value or cost of energy use over 30 years. This method accounts for the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade-based CO_2 emissions (California Energy Commission, 2023). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for measures in the 2025 Energy Code.

Energy simulations were completed using the 2025 research version of the Residential California Building Energy Code Compliance software (CBECC).

2.3.2 Costs

The Reach Codes Team assessed the incremental costs and savings of the packages over the lifecycle of 30-years. Incremental costs represent the equipment, installation, replacement, and maintenance costs of the proposed measure relative to the 2025 Energy Code minimum requirements or standard industry practices.

In February 2024, the TECH Clean California statewide program completed an incremental cost study from cost data collected from 64 contractor participants (Opinion Dynamics, 2024). This report directly uses the TECH costs for all the scenarios for which there was TECH cost data available. These costs were supplemented with measure costs the Reach Codes Team obtained from a contractor survey conducted in the summer of 2023. Additional detail on the contractor cost survey is available in the prior existing building statewide study (Statewide Reach Codes Team, 2024). The following summarizes key assumptions in this costing approach.

- Average statewide costs from the TECH Study were used, no regional specific costs were applied.
- Costs for 3-ton and 4-ton units were scaled for smaller and larger systems based on linear interpolation between the 3-ton and 4-ton costs.

- The TECH study provided cost for a minimum efficiency 60,000 Btu/h gas furnace. However, beginning in 2028, newly installed residential gas furnaces must comply with updated federal efficiency standards requiring a minimum of 95% AFUE[4]. Because the TECH study did not include cost estimates for a 95% AFUE condensing furnace, an adjustment was made using data from the statewide contractor cost survey. For systems requiring larger furnace capacities, cost estimates were derived as follows:
    - **80,000 Btu/h furnaces** (serving systems sized 3 tons): The cost difference between the minimum efficiency and 95% AFUE versions of the 80,000 Btu/h furnace and the cost difference between the minimum efficiency 80,000 Btu/h furnace and the minimum efficiency 60,000 Btu/h furnace, as reported in the contractor survey, was added to the TECH cost for the 60,000 Btu/h unit.
    - **100,000 Btu/h furnaces** (serving systems 4 tons and larger): The same method was applied using the corresponding cost differential for 100,000 Btu/h units.
- At time of replacement for the heat pump, based on heating loads and contractor feedback it is assumed an electric resistance backup coil would be installed with the air handler for Climate Zones 1 and 16. The CBECC-Res software applies back up electric resistance heating for all climate zones whenever it is assumed that the heat pump cannot meet the heating load based on the performance of currently available products (Heinemeier, 2025).The TECH costs did not include this option. The $819 incremental cost from the statewide study was added in this case.
- At the time of replacement for a furnace when it fails, the statewide study assumed a fan motor replacement. The TECH costs did not include this option. A $1,200 incremental cost was added to the TECH cost.
- At time of replacement for high efficiency heat pump, the sum of the TECH cost for standard efficiency heat pump and the incremental cost difference from the statewide study for high efficiency and standard efficiency heat pump was applied.

Costs were applied based on the system capacity from heating and cooling load calculations in CBECC-Res as presented in Table 4. Air conditioner nominal capacity was calculated as the CBECC-Res cooling load, rounded up to the nearest half ton. Heat pump nominal capacity was calculated as the maximum of either the CBECC-Res heating or cooling load, rounded up to the nearest half ton. In both cases a minimum capacity of 1.5-ton was applied as this represents the typical smallest available split system heat pump equipment. Load calculations revealed that Climate Zones 2 through 15 were cooling-dominated, whereas Climate Zones 1 and 16 were heating-dominated. In these heating-

[4] https://www.energy.gov/articles/doe-finalizes-energy-efficiency-standards-residential-furnaces-save-americans-15-billion#:~:text=These%20furnace%20efficiency%20standards%20were,heat%20for%20the%20living%20space.

dominated zones, the heat pump was upsized compared to an air conditioner designed solely for cooling to ensure adequate heating performance.

Table 4. System Sizing by Climate Zone

Climate Zone	Air Conditioner Capacity (tons)	Heat Pump Capacity (tons)
1	1.5	3.0
2	3.5	3.5
3	2.5	2.5
4	3.5	3.5
5	3.0	3.0
6	3.0	3.0
7	3.0	3.0
8	4.0	4.0
9	4.0	4.0
10	4.0	4.0
11	4.5	4.5
12	4.0	4.0
13	4.5	4.5
14	4.0	4.0
15	5.0	5.0
16	3.5	4.0

2.3.3 Metrics

Cost-effectiveness is presented using net present value (NPV).

- NPV: The Reach Codes Team uses net savings (NPV benefits minus NPV costs) as the cost-effectiveness metric. If the net savings of a measure or package is positive, it is considered cost effective. Negative net savings represent net costs to the consumer. A measure that has negative energy cost benefits (energy cost increase) can still be cost effective if the costs to implement the measure are even more negative (i.e., construction and maintenance cost savings).

Improving the energy performance of a building often requires an initial investment. In most cases the benefit is represented by annual On-Bill utility or LSC savings, and the cost by incremental first cost and replacement costs. However, some packages result in initial construction cost savings (negative incremental cost), and either energy cost savings (positive benefits), or increased energy costs (negative benefits). In cases where both construction costs and energy-related savings are negative, the construction cost savings are treated as the benefit while the increased energy costs are the cost. In cases where a measure or package is cost-effective immediately (i.e., upfront construction cost savings and lifetime energy cost savings).

2.3.4 Utility Rates

In coordination with the CA IOU rates team (comprised of representatives from Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E)) and two Publicly-Owned-Utilities (POUs) (Sacramento Municipal Utility District (SMUD) and City of Palo Alto Utilities (CPAU)), the Reach Codes Team determined appropriate utility rates for each climate zone to calculate utility costs and determine On-Bill cost-effectiveness for the proposed measures and packages. The utility tariffs, summarized in Table 5 and Table 6 with details in Section 6.2.26.2.2, were determined based on the appropriate rate for each. Utility rates were applied to each climate zone based on the predominant IOU serving the population of each zone, with a few climate zones evaluated multiple times under different utility scenarios. Climate Zones 10 and 14 were evaluated with both SCE for electricity and Southern California Gas Company (SoCalGas) for gas and SDG&E tariffs for both electricity and gas since each utility has customers within these climate zones. Climate Zone 5 is evaluated under both PG&E and SoCalGas natural gas rates. Two POU or municipal utility rates were also evaluated: SMUD in Climate Zone 12 and CPAU in Climate Zone 4.

First-year utility costs were calculated using hourly electricity and natural gas output from CBECC-Res and applying the utility tariffs summarized in Table 5 and Table 6. Homes with a heat pump in IOU territory are eligible for either the electrification or the standard tariff. Utility costs were calculated under both tariffs with results presented using the one that yielded the lower annual utility cost. The electrification tariff resulted in better utility costs savings when there was high kWh usage, typically in older, less efficient homes. Conversely, newer homes which are more efficient, tend to benefit more under the standard tariff. However, in SCE's milder climate zones, older homes benefit more under the standard tariff. Annual costs were also estimated for IOU customers eligible for the CARE tariff discounts on both electricity and natural gas bills.

Table 5. Investor-Owned Utility Tariffs Used Based on Climate Zone

Climate Zones	Electric / Gas Utility	Electricity Tariff: Standard Rate	Electricity Tariff: Electrification Rate	Natural Gas Tariff
1-5,11-13,16	PG&E / PG&E	E-TOU-C	E-ELEC	G1
5	PG&E / SoCalGas	E-TOU-C	E-ELEC	GR
6, 8-10, 14, 15	SCE / SoCalGas	TOU-D-4-9	TOU-D-PRIME	GR
7, 10, 14	SDG&E / SDG&E	TOU-DR-1	EV-TOU-5	GR

Table 6. Publicly Owned Utility Tariffs Used Based on Climate Zone

Climate Zones	Electric / Gas Utility Electricity Tariff: Standard Rate	Electricity Tariff: Electrification Rate	Natural Gas Tariff
4	CPAU / CPAU	E-1	G1
12	SMUD / PG&E	R-TOD	G1

Utility rates are assumed to escalate over time. Because it is very difficult to predict how rates will change, two escalation scenarios are presented in this study to represent a range of outcomes. See Appendix 6.3.7 Fuel Escalation Assumptions for details.

1) Modest Gas Escalation: This scenario is based on assumptions from the CPUC 2021 En Banc hearings on utility costs through 2030 (California Public Utilities Commission, 2021a). Escalation rates throughout the remainder of the 30-year evaluation period are based on the escalation rate assumptions within the 2022 Energy Code TDV factors developed by the Energy Commission (California Energy Commission. 2021b).
2) High Gas Escalation: This scenario is based on escalation rates developed by the Energy Commission and used within the 2025 Energy Code LSC factors (LSC replaces TDV in the 2025 Energy Code) which assumed steep increases in gas rates in the latter half of the analysis period.

Electricity tariff structures will evolve over time. Most recently, the CPUC approved an income-graduated fixed charge intended to benefit low-income customers and support electrification measures.[5] The IOUs are currently developing tariffs that meet the direction given by the CPUC in this proceeding. These tariffs were not available at the time of this study, but this analysis may be re-evaluated later in 2025 once the rates are finalized.

[5] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking

2.4 Measure Details and Cost

This section describes the details of the measures and documents incremental costs. All measure costs were obtained from the TECH cost survey and contractor survey unless otherwise noted. These surveys reflect the cost to the customer and include equipment, labor, permit fees, and required HERS testing.

The following heat pump space heater (HPSH) measures were evaluated as described below. All included HERS verified refrigerant charge, 10% duct sealing, and 300 CFM/ton airflow, aligned with the proposed code requirements for the 2025 Title 24 code.

1) **Dual Fuel Heat Pump (DFHP Existing Furnace)**: Replace existing ducted AC with an electric heat pump and install controls to operate the heat pump as the primary space conditioning source and to use the existing gas furnace (78 AFUE) for backup heat when heating demands cannot be met by the heat pump. In this report, dual fuel heat pumps were modeled to disable furnace operation above an outdoor temperature of 35°F in compliance with Energy Code Section 150.0(h)7, which requires this lockout for any heat pump with supplemental heating. A minimum federal efficiency (14.3 SEER2, 11.7 EER2, 7.5 HSPF2) heat pump was evaluated. Savings are compared to a new AC (14.3 SEER2, 11.7 EER2) alongside the existing furnace (78 AFUE). A new evaporator coil is assumed to be installed with the AC system.
2) **HPSH**: Replace existing ducted AC and natural gas furnace with an electric heat pump and air handler. Minimum federal efficiency (14.3 SEER2, 11.7 EER2, 7.5 HSPF2) heat pumps were evaluated. Savings are compared to a new ducted natural gas furnace and AC (14.3 SEER2, 11.7 EER2, 80 AFUE).
3) **High Efficiency HPSH**: Replace existing ducted AC and natural gas furnace with an electric heat pump and air handler. Higher efficiency (17 SEER2, 12.48 EER2, 9.5 HSPF2) heat pumps were evaluated. Savings are compared to a new ducted natural gas furnace and AC (14.3 SEER2, 11.7 EER2, 80 AFUE).

Over the 30-year analysis period, certain changes are assumed when the equipment is replaced that impact both lifetime costs and energy use. Table 7 and Table 8 present the lifetime scenario for the DFHP Existing Furnace and HPSH measures, respectively. The analysis assumed a 20-year effective useful lifetime (EUL) for a furnace, a 15-year EUL for an air conditioner and a 15-year EUL for a heat pump. Lifetimes are based on the Database for Energy Efficient Resources (DEER) (California Public Utilities Commission, 2021b). The existing furnace is assumed to be halfway through its EUL at the beginning of the analysis period. After 10 years when the furnace reaches the end of its life and needs to be replaced, it will be subject to new federal efficiency standards for residential gas furnaces that go into effect in 2028 requiring 95 AFUE[6]. Five years later the air conditioner reaches the end of its life and is replaced with a new air conditioner.

[6] https://www.energy.gov/articles/doe-finalizes-energy-efficiency-standards-residential-furnaces-save-americans-15-billion#:~:text=These%20furnace%20efficiency%20standards%20were,heat%20for%20the%20living%20space.

For the DFHP upgrade case, after 10 years when the furnace fails it's expected that the furnace is abandoned in place since the heat pump serves primary heating and was sized to provide the full design heating load. In this case it is assumed that the fan motor is replaced with a new aftermarket unit and operates another five years until the heat pump fails and is replaced with a new heat pump and air handler. Table 7 through Table 8 present the lifecycle incremental cost breakdown for a 4-ton system. The heat pump is sized for each climate zone based on the heating and cooling load as shown in Table 4, and the 4-ton system was selected as an example to show the lifecycle cost breakdown.

Table 7. Lifecycle Incremental Cost Breakdown for a 4-Ton DFHP Existing Furnace

Calendar Year	Baseline AC Replacement Schedule	Baseline Future Cost	Baseline Present Value Cost	Heat Pump	Heat Pump Future Cost	Heat Pump Present Value Cost
2026	AC fails, install new AC, keep existing furnace	$10,431	$10,431	AC fails, install new HP, keep existing furnace	$12,347	$12,347
2036	Furnace fails, install new 95AFUE furnace	$7,476	$5,563	Furnace fails, replace fan motor	$1,200	$893
2041	AC fails, install new AC	$10,431	$6,695	HP fails, install new HP and air handler	$14,529	$9,326
Total			$22,689			$22,566
Incremental Cost						**-$123**

Table 8. Lifecycle Incremental Cost Breakdown for 4-Ton HPSH

Calendar Year	Baseline AC Replacement Schedule	Baseline Future Cost	Baseline Present Value Cost	Heat Pump	Heat Pump Future Cost	Heat Pump Present Value Cost
2026	AC fails, install new AC & furnace	$13,808	$13,808	AC fails, install new HP & AHU	$14,529	$14,529
2041	AC fails, install new AC	$10,431	$6,695	HP fails, install new HP & AHU	$13,529	$8,684
2046	Furnace fails, install new 95AFUE furnace	$7,476	$4,139	-	-	-
2056	Remaining useful life for furnace	-	-$1,540	-	-	-
Total			$23,103			$23,213
Incremental Cost						**$110**

Table **9** presents estimated first and lifetime costs for the baseline and heat pump scenarios for 4-ton equipment. Costs include all material and installation labor including providing new 240 V electrical service to the air handler location for all new air handler installations and decommissioning of the furnace for the cases where the furnace is removed. DFHP costs incorporate controls installation and commissioning to ensure the heat pump and the furnace communicate properly and don't operate at the same time. Future replacement costs do not include any initial costs associated with 240V electrical service or furnace decommissioning.

Table 9. HVAC Measure Cost Assumptions – 4-Ton Electric Replacements

Measure Case	AC + Evaporator Coil	Gas Furnace /AC	DFHP Existing Furnace	HPSH	High Efficiency HPSH
Base Case	**-**	**-**	**AC + Evaporator Coil**	**Gas Furnace /AC**	**Gas Furnace /AC**
First Cost	$10,431	$13,808	$12,347	$14,529	$17,506
Replacement Cost (Future Value)	$17,907	$17,907	$15,729	$13,529	$16,506
Replacement Cost (Present Value)	$12,258	$11,639	$10,219	$8,684	$10,594
Remaining Value at Year 30	$0	-$1,540	$0	$0	$0
Total Lifecycle Cost	$22,689	$23,103	$22,566	$23,213	$28,100
Incremental Cost	**-**	**-**	**-$123**	**$110**	**$4,997**

2.4.1 Lifecycle Cost Assuming Zero-NOx Standards for Space Heating After 2030

The California Air Resource Board proposed a strategy for reducing emissions in their 2022 Scoping Plan for Achieving Carbon Neutrality that includes a zero-emission standard for space and water heaters sold in California that would go into effect in 2030 (California Air Resources Board, 2022).

The South Coast Air Quality Management District (SCAQMD) proposed Rule 1111 for the Reduction of NOx Emissions from Natural Gas-Fired Furnaces. This rule applies to furnaces less than 175,000 Btu/hr and sets compliance goals for manufacturers with the proposed dates in Table 10. The sale of gas furnaces above the compliance target will incur a mitigation fee (SCAQMD, 2025).

Table 10. SCAQMD Rule 1111 Proposed Manufacturer Compliance Targets

Target Dates	2027-2028	2029-2032	2033-2035	2036 and after
NOx Emitting Units (e.g. gas)	70%	50%	25%	10%
Zero-Emission Units	30%	50%	75%	90%

The Bay Area Air Quality Management District (BAAD) adopted Rule 9-4 that similarly requires zero NOx standards for space heating systems sold in the Bay Area. Implementation for residential furnaces will begin January 2029 (BAAD, 2025).

The BAAD Rule 9-4 has been adopted, but both the California Air Resources Board and SCAQMD Rule 1111 are proposed rules that have not yet been adopted, but given the implications these rulings would have on the 30-year cost-effectiveness if gas furnaces were very limited or no longer available in 2030, a sensitivity analysis for this scenario is included in this study for the DFHP Existing Furnace scenario. The other heat pump measures would also be impacted by this ruling; however, for simplicity the team selected one measure to give a sense of the impact on the results. The following costs reflect the scenario where gas furnaces are not available in 2030. This 30-year lifecycle analysis assumes that in 10 years when the furnace reaches the end of its useful life and needs to be replaced, it will be subjected to the SCAQMD Rule 1111 or California Air Resources Board proposal and will be replaced with a heat pump.

Table 11. Lifecycle Incremental Cost Breakdown for 4-Ton System with no Gas Furnaces after 2030

Calendar Year	Baseline AC Replacement Schedule	Baseline Future Cost	Baseline Present Value Cost	Heat Pump	Heat Pump Future Cost	Heat Pump Present Value Cost
2026	AC fails, install new AC, keep existing furnace	$10,431	$10,431	AC fails, install new HP, keep existing furnace	$12,347	$12,347
2036	Furnace fails, install new HP	$14,529	$10,811	Furnace fails, replace fan motor	$1,200	$893
2041	-	-	-	HP fails, install new HP and air handler	$14,529	$9,326
2051	HP fails, install new HP	$13,529	$6,462	-	-	-
2056	Remaining useful life for HP	-	-$4,459	-	-	-
Total			$23,244			$22,566
Incremental Cost						-$679

3 Results

The primary objective of the evaluation is to identify cost-effective HPSH upgrade measures for existing single family buildings, to support the design of local ordinances encouraging installation of a heat pump when replacing an air conditioner. While this section focuses primarily on the results of the cost-effectiveness analysis, it is important to highlight that the associated greenhouse gas (GHG) emissions savings are significant – averaging a 25% annual reduction across the climate zones and vintages. A full dataset of all results, including site energy, source energy, LSC and GHG emissions, can be downloaded at https://localenergycodes.com/content/resources. Results alongside policy options can also be explored using the Cost-effectiveness Explorer at https://explorer.localenergycodes.com/.

3.1 Cost-Effectiveness Results

Table 12 through Table 14 present results across the 16 climate zones for the 1992-2010 vintage using standard tariffs and Table 15 through Table 17 present results across the 16 climate zones and three vintages using CARE tariffs. Results show the incremental cost and utility bill savings for the first year along with cost effectiveness results for LSC and On-Bill under both the modest and high gas escalation scenarios. Results for additional vintages using standard tariffs are in Appendix 6.2 Cost-Effectiveness Results.

3.1.1 Cost Effectiveness Results Using Standard Tariffs

Table 12. [1992-2010] DFHP Existing Furnace

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$2,405	$60	$10,843	$5,471	$21,616
CZ02	PGE	$1,670	($86)	$8,387	$2,238	$12,692
CZ03	PGE	$1,178	$15	$8,383	$4,891	$13,958
CZ04	PGE	$1,670	($68)	$7,322	$1,880	$10,049
CZ04	CPAU	$1,670	($9)	$7,322	$2,132	$7,104
CZ05	PGE	$1,424	($12)	$6,848	$3,425	$11,150
CZ05	PGE/SCG	$1,424	($195)	$6,848	($1,864)	$2,099
CZ06	SCE/SCG	$1,424	($34)	$2,647	$675	$1,468
CZ07	SDGE	$1,424	($36)	$2,691	$599	$1,734
CZ08	SCE/SCG	$1,916	($65)	$1,879	($811)	$162
CZ09	SCE/SCG	$1,916	($90)	$2,600	($1,186)	$288
CZ10	SCE/SCG	$1,916	($79)	$2,295	($982)	$394
CZ10	SDGE	$1,916	$54	$2,295	$2,201	$4,708
CZ11	PGE	$2,162	$68	$7,597	$4,639	$14,675
CZ12	PGE	$1,916	$44	$8,317	$4,702	$15,222
CZ12	SMUD/PGE	$1,916	$353	$8,317	$11,622	$22,364
CZ13	PGE	$2,162	$76	$5,244	$3,897	$11,138
CZ14	SCE/SCG	$1,916	($179)	$4,654	($2,364)	$1,340
CZ14	SDGE	$1,916	($22)	$4,654	$1,282	$7,058
CZ15	SCE/SCG	$2,408	($133)	($271)	($3,438)	($3,209)
CZ16	PGE	$2,243	($66)	$8,842	$1,260	$11,982

Table 13. [1992-2010] Standard Efficiency HPSH

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$3,067	($145)	$10,949	($34)	$17,899
CZ02	PGE	$652	($229)	$9,362	($702)	$11,825
CZ03	PGE	$514	($62)	$8,244	$2,373	$11,665
CZ04	PGE	$652	($205)	$8,680	($572)	$10,753
CZ04	CPAU	$652	($85)	$8,680	$556	$7,194
CZ05	PGE	$583	($113)	$6,957	$752	$9,206
CZ05	PGE/SCG	$583	($316)	$6,957	($5,101)	($811)
CZ06	SCE/SCG	$583	($37)	$2,134	($63)	$716
CZ07	SDGE	$583	($39)	$2,156	($149)	$981
CZ08	SCE/SCG	$721	($79)	$1,812	($1,356)	($371)
CZ09	SCE/SCG	$721	($118)	$2,589	($2,038)	($524)
CZ10	SCE/SCG	$721	($103)	$2,311	($1,723)	($259)
CZ10	SDGE	$721	$34	$2,311	$1,533	$4,218
CZ11	PGE	$790	($35)	$8,817	$2,833	$14,504
CZ12	PGE	$721	($94)	$9,199	$1,812	$13,563
CZ12	SMUD/PGE	$721	$363	$9,199	$12,027	$24,107
CZ13	PGE	$790	$6	$5,948	$2,558	$10,687
CZ14	SCE/SCG	$721	($412)	$6,635	($6,964)	($1,073)
CZ14	SDGE	$721	($107)	$6,635	$166	$10,249
CZ15	SCE/SCG	$859	($139)	($112)	($3,434)	($3,186)
CZ16	PGE	$2,095	($385)	$13,600	($2,842)	$19,424

Table 14. [1992-2010] High Efficiency HPSH

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$5,998	$56	$9,783	($350)	$17,727
CZ02	PGE	$3,606	($94)	$7,527	($2,544)	$10,080
CZ03	PGE	$3,422	$59	$5,701	$312	$9,692
CZ04	PGE	$3,606	($61)	$6,961	($2,193)	$9,235
CZ04	CPAU	$3,606	$0	$6,961	($2,389)	$4,310
CZ05	PGE	$3,514	$4	$4,176	($1,450)	$7,088
CZ05	PGE/SCG	$3,514	($199)	$4,176	($7,303)	($2,929)
CZ06	SCE/SCG	$3,514	($14)	($2,162)	($4,367)	($3,567)
CZ07	SDGE	$3,514	($12)	($2,090)	($4,312)	($3,191)
CZ08	SCE/SCG	$3,698	$13	($1,660)	($4,217)	($3,149)
CZ09	SCE/SCG	$3,698	($26)	($750)	($4,883)	($3,284)
CZ10	SCE/SCG	$3,698	($4)	($844)	($4,418)	($2,864)
CZ10	SDGE	$3,698	$132	($844)	($1,068)	$1,587
CZ11	PGE	$3,789	$186	$7,738	$2,845	$14,675
CZ12	PGE	$3,698	$88	$7,575	$996	$12,879
CZ12	SMUD/PGE	$3,698	$422	$7,575	$8,459	$20,580
CZ13	PGE	$3,789	$208	$4,419	$2,165	$10,439
CZ14	SCE/SCG	$3,698	($219)	$5,760	($7,575)	($1,506)
CZ14	SDGE	$3,698	$77	$5,760	($424)	$9,604
CZ15	SCE/SCG	$3,881	$50	($2,144)	($4,209)	($3,786)
CZ16	PGE	$5,071	($97)	$14,557	($1,291)	$21,181

3.1.2 Cost Effectiveness Results Using CARE Tariffs

Table 15. [1992-2010] DFHP Existing Furnace CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$2,405	$153	$10,843	$6,436	$19,266
CZ02	PGE	$1,670	$18	$8,387	$3,842	$12,159
CZ03	PGE	$1,178	$73	$8,383	$5,574	$12,777
CZ04	PGE	$1,670	$14	$7,322	$3,143	$9,641
CZ04	CPAU	$1,670	$0	$7,322	$711	$711
CZ05	PGE	$1,424	$47	$6,848	$4,198	$10,337
CZ05	PGE/SCG	$1,424	($98)	$6,848	$23	$3,191
CZ06	SCE/SCG	$1,424	($18)	$2,647	$967	$1,600
CZ07	SDGE	$1,424	($16)	$2,691	$1,000	$1,887
CZ08	SCE/SCG	$1,916	($38)	$1,879	($285)	$495
CZ09	SCE/SCG	$1,916	($52)	$2,600	($450)	$731
CZ10	SCE/SCG	$1,916	($45)	$2,295	($331)	$771
CZ10	SDGE	$1,916	$51	$2,295	$1,998	$3,963
CZ11	PGE	$2,162	$115	$7,597	$4,993	$12,965
CZ12	PGE	$1,916	$103	$8,317	$5,287	$13,643
CZ12	SMUD/PGE	$1,916	$418	$8,317	$12,339	$20,922
CZ13	PGE	$2,162	$100	$5,244	$3,939	$9,686
CZ14	SCE/SCG	$1,916	($98)	$4,654	($849)	$2,119
CZ14	SDGE	$1,916	$23	$4,654	$2,007	$6,528
CZ15	SCE/SCG	$2,408	($88)	($271)	($2,456)	($2,260)
CZ16	PGE	$2,243	$33	$8,842	$2,737	$11,267

Table 16. [1992-2010] Standard Efficiency HPSH CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$3,067	$33	$10,949	$2,703	$16,973
CZ02	PGE	$652	($59)	$9,362	$2,211	$12,188
CZ03	PGE	$514	$25	$8,244	$3,685	$11,074
CZ04	PGE	$652	($53)	$8,680	$2,048	$11,067
CZ04	CPAU	$652	$0	$8,680	$255	$255
CZ05	PGE	$583	($13)	$6,957	$2,389	$9,117
CZ05	PGE/SCG	$583	($173)	$6,957	($2,232)	$1,208
CZ06	SCE/SCG	$583	($20)	$2,134	$249	$872
CZ07	SDGE	$583	($18)	$2,156	$279	$1,161
CZ08	SCE/SCG	$721	($47)	$1,812	($728)	$62
CZ09	SCE/SCG	$721	($70)	$2,589	($1,094)	$122
CZ10	SCE/SCG	$721	($61)	$2,311	($892)	$281
CZ10	SDGE	$721	$39	$2,311	$1,509	$3,612
CZ11	PGE	$790	$60	$8,817	$4,141	$13,421
CZ12	PGE	$721	$22	$9,199	$3,592	$12,940
CZ12	SMUD/PGE	$721	$471	$9,199	$13,622	$23,292
CZ13	PGE	$790	$61	$5,948	$3,234	$9,693
CZ14	SCE/SCG	$721	($241)	$6,635	($3,632)	$1,098
CZ14	SDGE	$721	($5)	$6,635	$1,996	$9,885
CZ15	SCE/SCG	$859	($91)	($112)	($2,414)	($2,201)
CZ16	PGE	$2,095	($92)	$13,600	$2,163	$19,892

Table 17. [1992-2010] High Efficiency HPSH CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$5,998	$164	$9,783	$813	$15,177
CZ02	PGE	$3,606	$28	$7,527	($683)	$9,357
CZ03	PGE	$3,422	$104	$5,701	$674	$8,120
CZ04	PGE	$3,606	$41	$6,961	($703)	$8,383
CZ04	CPAU	$3,606	$0	$6,961	($4,595)	($4,595)
CZ05	PGE	$3,514	$62	$4,176	($727)	$6,056
CZ05	PGE/SCG	$3,514	($98)	$4,176	($5,348)	($1,853)
CZ06	SCE/SCG	$3,514	($5)	($2,162)	($4,219)	($3,583)
CZ07	SDGE	$3,514	($0)	($2,090)	($4,112)	($3,235)
CZ08	SCE/SCG	$3,698	$15	($1,660)	($4,248)	($3,401)
CZ09	SCE/SCG	$3,698	($8)	($750)	($4,603)	($3,330)
CZ10	SCE/SCG	$3,698	$6	($844)	($4,300)	($3,065)
CZ10	SDGE	$3,698	$103	($844)	($1,892)	$191
CZ11	PGE	$3,789	$203	$7,738	$2,425	$11,808
CZ12	PGE	$3,698	$141	$7,575	$1,351	$10,784
CZ12	SMUD/PGE	$3,698	$471	$7,575	$8,735	$18,405
CZ13	PGE	$3,789	$192	$4,419	$1,255	$7,809
CZ14	SCE/SCG	$3,698	($111)	$5,760	($5,632)	($783)
CZ14	SDGE	$3,698	$115	$5,760	($98)	$7,755
CZ15	SCE/SCG	$3,881	$36	($2,144)	($4,549)	($4,220)
CZ16	PGE	$5,071	$95	$14,557	$1,460	$19,324

3.2 Zero-NOx Scenario Results

This section presents cost-effectiveness results for the DFHP Existing Furnace under the scenario where proposed air quality district zero-NOx rules go into effect over the next 10 years. In the base case, at time of replacement of the gas furnace at year 10 a heat pump is installed. The energy profile between the base case and the heat pump upgrade case are subsequently identical for the remaining 20 years of the 30-year analysis period. As a result, energy and cost savings only persist for the first 10 years.

Table 18 shows the On-Bill NPV cost-effectiveness results and Table 19 the LSC cost-effectiveness results for all three vintages. 2025 LSC savings were calculated using individual year multipliers for the first 10 years, 2026 through 2035.

Table 18. DFHP Existing Furnace On-Bill NPV (Zero-NOx Rule)

Climate Zone	Electric/ Gas Utility	On-Bill NPV		
		Pre-1978	1978-1991	1992-2010
CZ01	PGE	$5,473	$4,136	$2,349
CZ02	PGE	$1,785	$1,031	$1,101
CZ03	PGE	$2,863	$2,097	$2,052
CZ04	PGE	$2,133	$1,162	$1,019
CZ04	CPAU	$2,340	$1,599	$1,213
CZ05	PGE	$1,918	$1,486	$1,576
CZ05	PGE/SCG	($1,308)	($834)	($491)
CZ06	SCE/SCG	$401	$605	$635
CZ07	SDGE	$1,473	$999	$641
CZ08	SCE/SCG	($125)	$99	$195
CZ09	SCE/SCG	($563)	($183)	$22
CZ10	SCE/SCG	($259)	$53	$110
CZ10	SDGE	$2,985	$2,261	$1,430
CZ11	PGE	$3,287	$2,866	$2,279
CZ12	PGE	$2,935	$2,578	$2,202
CZ12	SMUD/PGE	$7,877	$5,978	$5,040
CZ13	PGE	$2,927	$2,556	$2,053
CZ14	SCE/SCG	($864)	($943)	($543)
CZ14	SDGE	$2,204	$1,655	$1,064
CZ15	SCE/SCG	$1,338	$396	($688)
CZ16	PGE	$1,192	$1,071	$1,096

Table 19. DFHP Existing Furnace LSC Savings (Zero-NOx Rule)

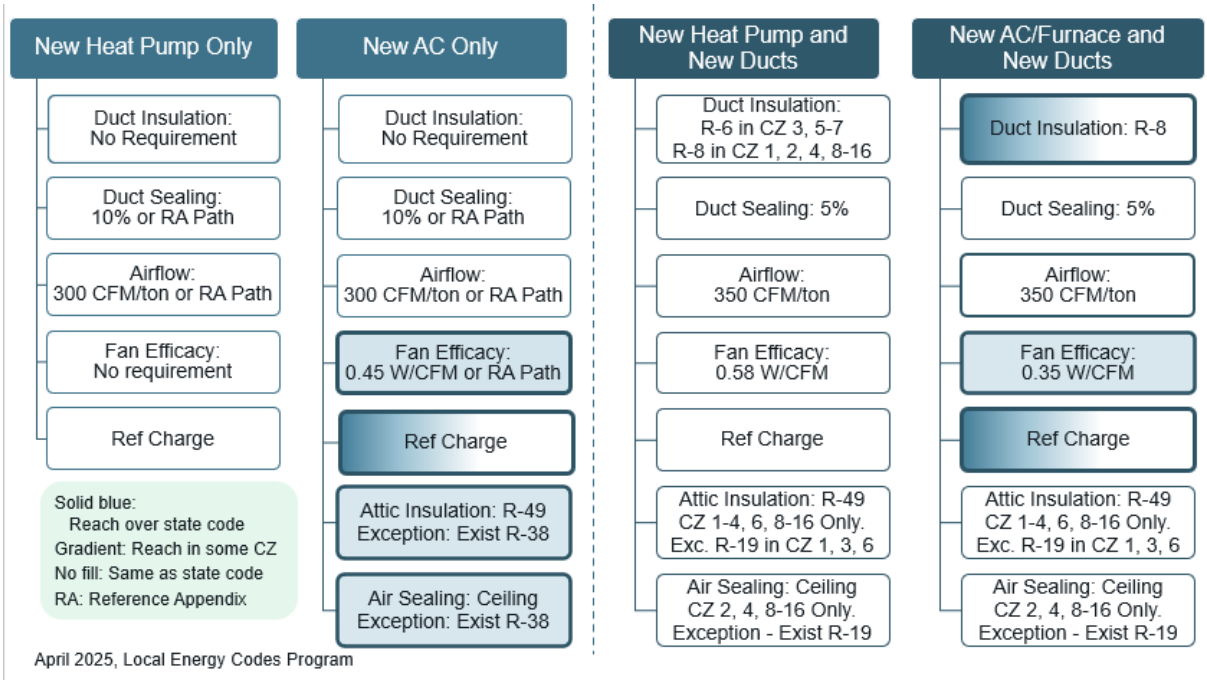
Climate Zone	Electric/ Gas Utility	LSC NPV		
		Pre-1978	1978-1991	1992-2010
CZ01	PGE	$3,019	$2,510	$1,558
CZ02	PGE	$1,256	$1,025	$1,006
CZ03	PGE	$1,460	$1,120	$1,036
CZ04	PGE	$1,242	$949	$887
CZ04	CPAU	$1,242	$949	$887
CZ05	PGE	$1,127	$816	$820
CZ05	PGE/SCG	$1,127	$816	$820
CZ06	SCE/SCG	$545	$318	$251
CZ07	SDGE	$639	$403	$314
CZ08	SCE/SCG	$428	$279	$244
CZ09	SCE/SCG	$608	$424	$372
CZ10	SCE/SCG	$469	$320	$293
CZ10	SDGE	$469	$320	$293
CZ11	PGE	$1,871	$1,475	$1,263
CZ12	PGE	$1,924	$1,539	$1,356
CZ12	SMUD/PGE	$1,375	$1,090	$939
CZ13	PGE	($206)	($186)	$50
CZ14	SCE/SCG	($206)	($186)	$50
CZ14	SDGE	$127	$60	$38
CZ15	SCE/SCG	($185)	($12)	$77
CZ16	PGE	$3,019	$2,510	$1,558

3.3 AC Pathways for Heat Pump Replacements

Many jurisdictions are interested in seeing alternative pathways for residents who may prefer to replace an air conditioner with similar equipment, rather than migrating to a heat pump system. Alternative packages analyzed to support this request include air conditioning equipment combined with additional efficiency measures resulting in options that are reasonably energy or LSC cost equivalent to a heat pump system, to the extent feasible.

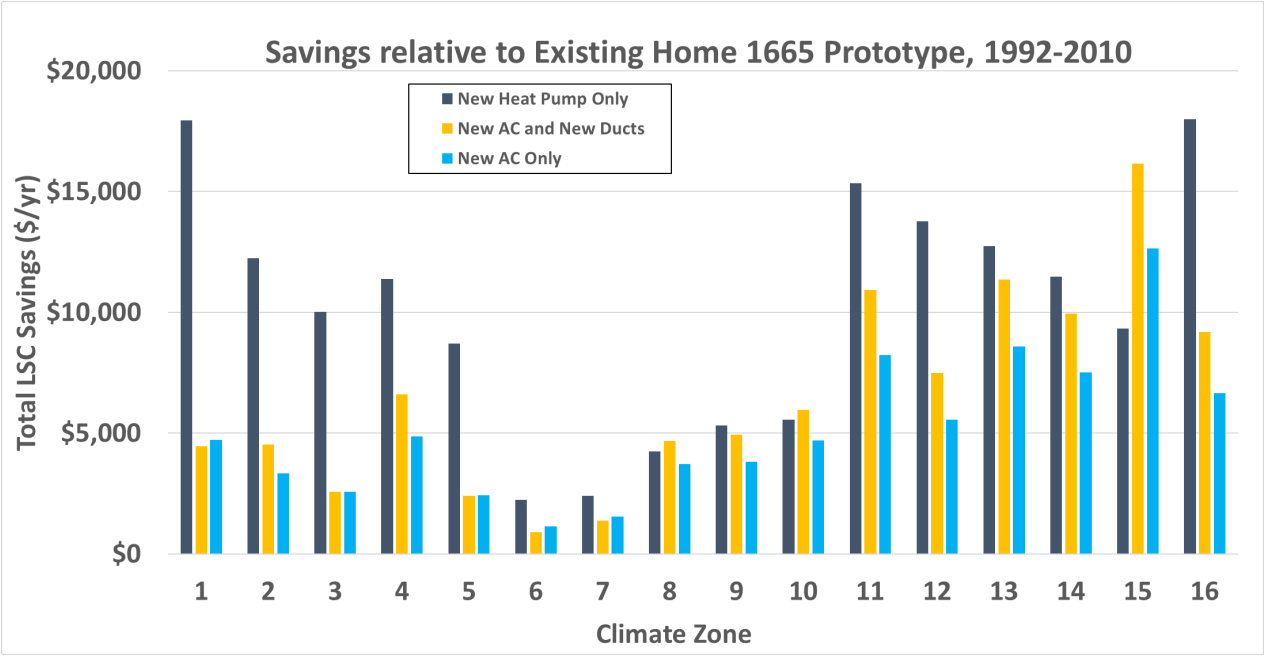
Figure 1 shows two AC pathways, one with an existing duct system and another path with a new duct system, alongside the heat pump pathways. The figure presents the proposed efficiency upgrade measures that would be part of a reach code (solid blue) along with the relevant requirements from Title 24, Part 6 that are triggered as part of equipment replacements (white or gradient blue). A reach code that establishes requirements when an air conditioner is replaced or installed new could allow for either a heat pump to be installed or an AC as long as the performance measures listed below are met.

Figure 1. AC vs. Heat Pump Pathway Requirements



The heat pump only and two AC pathways are presented in Figure 2 comparing total LSC energy use relative to the existing home for the 1992-2010 vintage. The heat pump path is represented by the DFHP Existing Furnace scenario. In most climate zones, the heat pump path results in higher energy savings, in the milder climates the AC and new ducts and New AC Only paths save marginally more energy.

Figure 2. AC vs. Heat Pump Energy Comparison



Though the AC path does not need to meet cost-effectiveness criteria to be adopted as a reach code since it's an alternative path, in order to understand the implications of the AC path on the customer, Table 20 and Table 21 present estimated costs for the new AC only and the new AC + new ducts paths respectively.

Table 20. New AC Only Path Cost Estimates

New AC Only Path	Pre-1978	1978-1991	1992-2010
Fan Efficacy: 0.45 W/CFM	-	-	-
Refrigerant Charge Verification	$100	$100	$100[7]
R-49 Attic Insulation	$5,483	$3,612	$1,827
Air Sealing	$1,963	$1,963	$1,963
Total	**$7,546**	**$5,675**	**$3,790**

Table 21. New AC/Furnace and New Ducts Path Cost Estimates

New AC and New Ducts Path	Pre-1978	1978-1991	1992-2010
New R-8 Ducts	$6,311	$6,311	$6,311
Furnace	$5,951	$5,951	$5,951
Fan Efficacy: 0.35 W/CFM	$500	$500	$500
Refrigerant Charge Verification	$100	$100	$100
Total	**$12,862**	**$12,862**	**$12,862**

[7] *This is an incremental cost and in some climate zones, refrigerant charge verification is required so there is no incremental cost added.*

4 Recommendations and Discussion

This analysis evaluated the feasibility and cost-effectiveness of AC to heat pump measures in California existing homes built before 2010. To meet the needs of jurisdictions evaluating this option, Statewide Reach Codes Team used both On-Bill and LSC-based lifecycle cost approaches to evaluate cost-effectiveness and quantify the energy cost savings associated with energy efficiency measures compared to the incremental costs associated with the measures.

Conclusions and Discussion:

1. Heat pumps are significantly more efficient than gas furnaces, requiring less than half the energy to meet the heating load. However, despite this reduction in heating energy use, the cost of heating a home using electricity (heat pump) could be higher than the cost to heat that same home with natural gas (furnace), depending on the electricity tariffs relative to the gas tariffs. Therefore, while a heat pump measure could be deemed as cost-effective over its lifecycle, installing a heat pump could result in a decrease *or* an increase in utility costs in the first years relative to a gas furnace and AC system. For example, the heat pump space heater measure in climate zone 12 in the newest vintage results in the customer saving money on their utility bill in SMUD territory but paying more on their utility bill in PG&E territory. Both PG&E and SMUD territory use PG&E gas rates, but SMUD has lower electricity rates than PG&E. With fuel switching measures like the AC to HP measure, the electricity to gas ratio has a significant impact on the savings or costs the customer will see by switching from gas to an electric heat pump space heater.
2. The LSC metric most often produces more favorable cost-effectiveness results relative to the results produced using actual utility costs (On-Bill). When the analysis assumes a higher escalation rate for natural gas costs relative to electricity in future years (high gas escalation), the On-Bill results are more favorable in some cases.
    a. In the oldest (pre-1978) vintage, all three measures (dual fuel heat pump with existing furnace, standard heat pump space heater, and high efficiency heat pump space heater) are cost-effective using the LSC metric in all climate zones. When using the On-Bill metric, the measures remain cost-effective in most climate zones.
    b. In the newer (1978-1991 and 1992-2010) vintages, the dual fuel heat pump (DFHP Existing Furnace) and the standard efficiency HPSH are cost-effective based on LSC in all cases except for Climate Zone 15 when using both the standard and California Alternative Rates for Energy (CARE) tariff.
3. Using the CARE tariff results in higher cost savings and cost-effectiveness relative to standard rates, with almost all cases yielding first year utility cost savings. The DFHP Existing Furnace is On-Bill cost-effective based on the high gas escalation scenario in all cases in the pre-1978 vintage, and almost all cases in the 1978-1991 and 1992-2010 vintage. It is also On-Bill cost-effective in most climate zones for the

modest gas escalation scenario across all vintages. In Climate Zones 5, 8, 9, 10, 14, and 15, cost-effectiveness declines relative to other areas, and in some cases is not cost-effective from an On-Bill perspective. This is the case for both the CARE tariff and the standard rate.

4. The analysis also modeled the cost impact of using a standard time-of-use electricity tariff versus switching to a newer electrification tariff, designed to reduce costs in homes with heat pumps and/or electric vehicles. Older homes tend to be the least efficient and achieve the most savings from improving equipment efficiency. In most of the state, because older homes tend to use more electricity than a similarly sized, newer vintage home, they realize more costs savings under the electrification tariff. Newer homes tend to use less electricity and therefore do not realize the same cost savings from switching tariffs; they generally perform better under the standard tariff. This trend is different in milder climate zones in SCE territory (excluding CZ 15), where newer homes realize more cost savings than older homes. Both the standard and electrification tariffs in SCE territory include a daily allocation of lower-cost baseline electricity and a second, higher-priced tier when the baseline is exceeded. In many newer homes, a higher percentage of overall electricity use is within the baseline allocation, resulting in greater cost savings.
5. Higher efficiency equipment reduces utility costs in all cases and improves cost-effectiveness in many climate zones in the oldest vintage relative to standard efficiency equipment. However, in more efficient newer homes, where cost-effectiveness is generally lower, the savings are insufficient to offset the roughly $3,000 increase in incremental cost.
6. Given the adopted Bay Area Air Quality Management District Zero NOx rule, and the proposed California Air Resource Board or South Coast Air Quality Management District (SCAQMD) Zero-NOx rules, and gas furnaces may not be available to be installed in 2030, a sensitivity analysis was performed for the Zero NOx scenario and found that cost-effectiveness decreases in many cases except in Climate Zones 8-10, some results improve enough to become cost-effective. The improved cost-effectiveness in Climate Zones 8-10 is due to the higher baseline cost when a HPSH must be installed at year 10 when the furnace must be replaced. However, the overall magnitude of 30-year On-Bill cost-effectiveness is lower because there are only 10 years of utility cost savings. After year 10 the base case and upgrade measures are both heat pumps.
7. While not evaluated in this report, the *2022 Single Family Retrofit Cost-effectiveness Study* (Statewide Reach Codes Team, 2024) shows it is beneficial to combine a heat pump space conditioning system with photovoltaics (PV) because the additional electricity required by the heat pump can be met by the PV system and result in reduced utility bills.
8. In this study the dual fuel heat pump is evaluated with an existing furnace, however the homeowner could choose to replace the existing furnace with a new furnace at

this time as well. This measure (DFHP New Furnace) was evaluated in the *2022 Single Family Retrofit Cost-effectiveness Study* (Statewide Reach Codes Team, 2024) but found to be less cost-effective than the DFHP Existing Furnace case.

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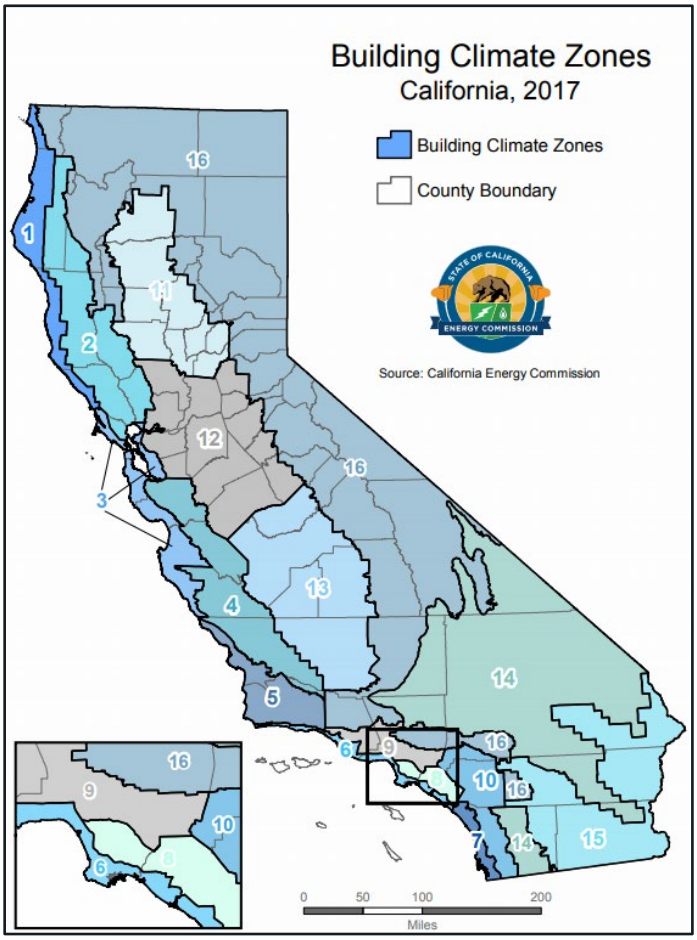
6 Appendices

6.1 Map of California Climate Zones

Climate zone geographical boundaries are depicted in Figure 3. The map in Figure 3 along with a zip-code search directory is available at:
https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html

Figure 3. Map of California climate zones.



6.2 Cost-Effectiveness Results

6.2.1 Standard Rates

The following tables present results across the16 climate zones for the pre-1978 (Table 22 through Table 24) and the 1978-1991 (Table 25 through Table 27) vintages supplementing the results in Section 3.

Table 22. [Pre-1978] DFHP Existing Furnace

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$2,405	$155	$25,223	$14,524	$51,831
CZ02	PGE	$1,670	($81)	$11,551	$4,316	$20,806
CZ03	PGE	$1,178	$39	$11,680	$7,248	$21,906
CZ04	PGE	$1,670	($7)	$10,574	$4,948	$18,321
CZ04	CPAU	$1,670	$63	$10,574	$5,177	$14,531
CZ05	PGE	$1,424	($29)	$9,462	$4,574	$16,955
CZ05	PGE/SCG	$1,424	($314)	$9,462	($3,674)	$2,838
CZ06	SCE/SCG	$1,424	($70)	$4,223	$179	$1,795
CZ07	SDGE	$1,424	$41	$4,278	$2,725	$5,055
CZ08	SCE/SCG	$1,916	($111)	$3,216	($1,507)	$375
CZ09	SCE/SCG	$1,916	($168)	$4,238	($2,500)	$125
CZ10	SCE/SCG	$1,916	($133)	$3,755	($1,774)	$774
CZ10	SDGE	$1,916	$201	$3,755	$6,175	$10,683
CZ11	PGE	$2,162	$93	$11,970	$7,593	$24,951
CZ12	PGE	$1,916	$46	$12,302	$6,948	$24,190
CZ12	SMUD/PGE	$1,916	$584	$12,302	$18,997	$36,626
CZ13	PGE	$2,162	$112	$8,180	$6,374	$18,740
CZ14	SCE/SCG	$1,916	($244)	$6,646	($2,926)	$3,332
CZ14	SDGE	$1,916	$65	$6,646	$4,203	$13,297
CZ15	SCE/SCG	$2,408	$80	$401	$1,506	$2,532
CZ16	PGE	$2,243	($199)	$17,538	$2,333	$25,276

Table 23. [Pre-1978] Standard Efficiency HPSH

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$3,067	($127)	$27,155	$7,800	$48,445
CZ02	PGE	$652	($242)	$13,342	$1,420	$21,282
CZ03	PGE	$514	($46)	$11,946	$4,614	$19,670
CZ04	PGE	$652	($139)	$13,059	$3,274	$21,888
CZ04	CPAU	$652	($48)	$13,059	$3,194	$15,372
CZ05	PGE	$583	($131)	$9,998	$2,045	$15,648
CZ05	PGE/SCG	$583	($449)	$9,998	($7,152)	($94)
CZ06	SCE/SCG	$583	($76)	$3,860	($652)	$931
CZ07	SDGE	$583	$35	$3,876	$1,901	$4,218
CZ08	SCE/SCG	$721	($128)	$3,305	($2,112)	($199)
CZ09	SCE/SCG	$721	($219)	$4,415	($3,839)	($1,141)
CZ10	SCE/SCG	$721	($188)	$3,982	($3,168)	($483)
CZ10	SDGE	$721	$166	$3,982	$5,200	$10,049
CZ11	PGE	$790	($74)	$14,045	$4,727	$24,836
CZ12	PGE	$721	($179)	$13,850	$2,374	$21,622
CZ12	SMUD/PGE	$721	$601	$13,850	$19,845	$39,654
CZ13	PGE	$790	($14)	$9,394	$3,998	$17,858
CZ14	SCE/SCG	$721	($450)	$10,103	($6,294)	$4,015
CZ14	SDGE	$721	($66)	$10,103	$2,757	$18,994
CZ15	SCE/SCG	$859	$68	$643	$1,364	$2,430
CZ16	PGE	$2,095	($484)	$27,492	$2,918	$49,419

Table 24. [Pre-1978] High Efficiency HPSH

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$5,998	$249	$30,518	$11,401	$52,316
CZ02	PGE	$3,606	($24)	$13,354	$1,431	$21,449
CZ03	PGE	$3,422	$100	$10,768	$3,122	$18,282
CZ04	PGE	$3,606	$118	$13,537	$4,185	$22,984
CZ04	CPAU	$3,606	$101	$13,537	$1,665	$13,950
CZ05	PGE	$3,514	$10	$8,416	$384	$14,087
CZ05	PGE/SCG	$3,514	($308)	$8,416	($8,814)	($1,654)
CZ06	SCE/SCG	$3,514	$3	$380	($3,709)	($2,052)
CZ07	SDGE	$3,514	$114	$430	($1,063)	$1,230
CZ08	SCE/SCG	$3,698	$31	$1,065	($3,478)	($1,420)
CZ09	SCE/SCG	$3,698	($40)	$2,358	($4,759)	($1,897)
CZ10	SCE/SCG	$3,698	$6	$2,191	($3,746)	($882)
CZ10	SDGE	$3,698	$344	$2,191	$4,481	$9,276
CZ11	PGE	$3,789	$283	$15,614	$7,801	$28,167
CZ12	PGE	$3,698	$152	$14,490	$4,899	$24,385
CZ12	SMUD/PGE	$3,698	$708	$14,490	$17,350	$37,236
CZ13	PGE	$3,789	$326	$10,164	$6,697	$20,802
CZ14	SCE/SCG	$3,698	($173)	$11,876	($5,041)	$5,522
CZ14	SDGE	$3,698	$244	$11,876	$5,111	$21,254
CZ15	SCE/SCG	$3,881	$335	$393	$2,323	$3,635
CZ16	PGE	$5,071	$45	$34,043	$9,856	$56,737

Table 25. [1978-1991] DFHP Existing Furnace

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$2,405	$99	$20,184	$10,746	$40,368
CZ02	PGE	$1,670	($114)	$9,142	$2,185	$14,361
CZ03	PGE	$1,178	$3	$9,033	$5,101	$15,624
CZ04	PGE	$1,670	($68)	$8,160	$2,319	$11,818
CZ04	CPAU	$1,670	$18	$8,160	$3,161	$9,418
CZ05	PGE	$1,424	($32)	$7,070	$3,268	$11,902
CZ05	PGE/SCG	$1,424	($238)	$7,070	($2,666)	$1,747
CZ06	SCE/SCG	$1,424	($39)	$2,941	$614	$1,557
CZ07	SDGE	$1,424	$1	$3,046	$1,512	$2,837
CZ08	SCE/SCG	$1,916	($78)	$2,145	($1,026)	$145
CZ09	SCE/SCG	$1,916	($116)	$2,978	($1,655)	$122
CZ10	SCE/SCG	$1,916	($89)	$2,606	($1,096)	$571
CZ10	SDGE	$1,916	$139	$2,606	$4,321	$7,320
CZ11	PGE	$2,162	$103	$9,118	$6,239	$18,777
CZ12	PGE	$1,916	$60	$9,604	$5,770	$18,506
CZ12	SMUD/PGE	$1,916	$430	$9,604	$14,059	$27,062
CZ13	PGE	$2,162	$111	$6,237	$5,242	$14,247
CZ14	SCE/SCG	$1,916	($230)	$4,931	($3,277)	$1,039
CZ14	SDGE	$1,916	$35	$4,931	$2,793	$9,271
CZ15	SCE/SCG	$2,408	($17)	($99)	($807)	($310)
CZ16	PGE	$2,243	($161)	$14,397	$1,740	$20,318

Table 26. [1978-1991] Standard Efficiency HPSH

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$3,067	($128)	$21,427	$5,043	$37,346
CZ02	PGE	$652	($235)	$10,428	($90)	$14,711
CZ03	PGE	$514	($67)	$8,999	$2,767	$13,608
CZ04	PGE	$652	($164)	$9,984	$1,062	$14,605
CZ04	CPAU	$652	($66)	$9,984	$1,535	$9,914
CZ05	PGE	$583	($132)	$7,290	$703	$10,264
CZ05	PGE/SCG	$583	($361)	$7,290	($5,939)	($1,104)
CZ06	SCE/SCG	$583	($43)	$2,450	($151)	$775
CZ07	SDGE	$583	($3)	$2,539	$747	$2,065
CZ08	SCE/SCG	$721	($96)	$2,111	($1,658)	($472)
CZ09	SCE/SCG	$721	($152)	$3,022	($2,659)	($831)
CZ10	SCE/SCG	$721	($121)	$2,672	($2,017)	($239)
CZ10	SDGE	$721	$114	$2,672	$3,568	$6,801
CZ11	PGE	$790	($46)	$10,682	$3,545	$18,156
CZ12	PGE	$721	($110)	$10,747	$2,278	$16,574
CZ12	SMUD/PGE	$721	$445	$10,747	$14,697	$29,392
CZ13	PGE	$790	$1	$7,141	$3,112	$13,232
CZ14	SCE/SCG	$721	($398)	$7,556	($6,191)	$1,058
CZ14	SDGE	$721	($53)	$7,556	$1,909	$13,834
CZ15	SCE/SCG	$859	($25)	$71	($848)	($322)
CZ16	PGE	$2,095	($445)	$22,236	$708	$37,873

Table 27. [1978-1991] High Efficiency HPSH

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$5,998	$169	$23,092	$6,895	$39,412
CZ02	PGE	$3,606	($75)	$9,242	($1,370)	$13,547
CZ03	PGE	$3,422	$53	$6,872	$675	$11,602
CZ04	PGE	$3,606	$26	$9,114	$463	$14,143
CZ04	CPAU	$3,606	$43	$9,114	($868)	$7,590
CZ05	PGE	$3,514	($16)	$4,859	($1,522)	$8,122
CZ05	PGE/SCG	$3,514	($246)	$4,859	($8,164)	($3,246)
CZ06	SCE/SCG	$3,514	($1)	($1,546)	($4,024)	($3,059)
CZ07	SDGE	$3,514	$47	($1,407)	($2,879)	($1,576)
CZ08	SCE/SCG	$3,698	$37	($828)	($3,608)	($2,300)
CZ09	SCE/SCG	$3,698	($17)	$232	($4,573)	($2,623)
CZ10	SCE/SCG	$3,698	$20	$82	($3,764)	($1,856)
CZ10	SDGE	$3,698	$251	$82	$1,869	$5,060
CZ11	PGE	$3,789	$259	$10,685	$5,452	$20,283
CZ12	PGE	$3,698	$138	$10,023	$2,954	$17,430
CZ12	SMUD/PGE	$3,698	$525	$10,023	$11,609	$26,363
CZ13	PGE	$3,789	$289	$6,612	$4,624	$14,951
CZ14	SCE/SCG	$3,698	($188)	$7,697	($6,429)	$1,012
CZ14	SDGE	$3,698	$182	$7,697	$2,525	$14,378
CZ15	SCE/SCG	$3,881	$193	($1,111)	($992)	($267)
CZ16	PGE	$5,071	($30)	$26,407	$5,118	$42,581

6.2.2 CARE tariffs

Table 28. [Pre-1978] DFHP Existing Furnace CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$2,405	$364	$25,223	$16,641	$46,300
CZ02	PGE	$1,670	$64	$11,551	$6,432	$19,553
CZ03	PGE	$1,178	$128	$11,680	$8,248	$19,898
CZ04	PGE	$1,670	$90	$10,574	$6,198	$16,835
CZ04	CPAU	$1,670	$0	$10,574	$711	$711
CZ05	PGE	$1,424	$69	$9,462	$5,901	$15,746
CZ05	PGE/SCG	$1,424	($157)	$9,462	($613)	$4,598
CZ06	SCE/SCG	$1,424	($37)	$4,223	$776	$2,067
CZ07	SDGE	$1,424	$42	$4,278	$2,609	$4,434
CZ08	SCE/SCG	$1,916	($63)	$3,216	($595)	$911
CZ09	SCE/SCG	$1,916	($97)	$4,238	($1,132)	$972
CZ10	SCE/SCG	$1,916	($75)	$3,755	($660)	$1,379
CZ10	SDGE	$1,916	$160	$3,755	$4,963	$8,500
CZ11	PGE	$2,162	$183	$11,970	$8,415	$22,212
CZ12	PGE	$1,916	$152	$12,302	$8,126	$21,834
CZ12	SMUD/PGE	$1,916	$686	$12,302	$20,080	$34,172
CZ13	PGE	$2,162	$160	$8,180	$6,595	$16,418
CZ14	SCE/SCG	$1,916	($126)	$6,646	($779)	$4,233
CZ14	SDGE	$1,916	$101	$6,646	$4,530	$11,652
CZ15	SCE/SCG	$2,408	$60	$401	$982	$1,788
CZ16	PGE	$2,243	$34	$17,538	$5,963	$24,236

Table 29. [Pre-1978] Standard Efficiency HPSH CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$3,067	$205	$27,155	$12,440	$44,777
CZ02	PGE	$652	($16)	$13,342	$5,095	$20,910
CZ03	PGE	$514	$76	$11,946	$6,319	$18,293
CZ04	PGE	$652	$41	$13,059	$6,031	$20,843
CZ04	CPAU	$652	$0	$13,059	$255	$255
CZ05	PGE	$583	$12	$9,998	$4,285	$15,110
CZ05	PGE/SCG	$583	($240)	$9,998	($2,978)	$2,679
CZ06	SCE/SCG	$583	($42)	$3,860	($7)	$1,259
CZ07	SDGE	$583	$37	$3,876	$1,837	$3,652
CZ08	SCE/SCG	$721	($75)	$3,305	($1,076)	$457
CZ09	SCE/SCG	$721	($131)	$4,415	($2,095)	$72
CZ10	SCE/SCG	$721	($110)	$3,982	($1,649)	$504
CZ10	SDGE	$721	$139	$3,982	$4,305	$8,106
CZ11	PGE	$790	$94	$14,045	$7,108	$23,108
CZ12	PGE	$721	$20	$13,850	$5,506	$20,829
CZ12	SMUD/PGE	$721	$772	$13,850	$22,326	$38,189
CZ13	PGE	$790	$89	$9,394	$5,347	$16,369
CZ14	SCE/SCG	$721	($241)	$10,103	($2,418)	$5,836
CZ14	SDGE	$721	$62	$10,103	$4,832	$17,541
CZ15	SCE/SCG	$859	$52	$643	$930	$1,769
CZ16	PGE	$2,095	$16	$27,492	$10,883	$47,907

Table 30. [Pre-1978] High Efficiency HPSH CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$5,998	$450	$30,518	$13,096	$45,609
CZ02	PGE	$3,606	$126	$13,354	$3,405	$19,322
CZ03	PGE	$3,422	$172	$10,768	$3,678	$15,720
CZ04	PGE	$3,606	$209	$13,537	$4,926	$19,859
CZ04	CPAU	$3,606	$0	$13,537	($4,595)	($4,595)
CZ05	PGE	$3,514	$103	$8,416	$1,521	$12,412
CZ05	PGE/SCG	$3,514	($148)	$8,416	($5,742)	($19)
CZ06	SCE/SCG	$3,514	$11	$380	($3,634)	($2,319)
CZ07	SDGE	$3,514	$89	$430	($1,774)	$25
CZ08	SCE/SCG	$3,698	$33	$1,065	($3,586)	($1,955)
CZ09	SCE/SCG	$3,698	($10)	$2,358	($4,304)	($2,027)
CZ10	SCE/SCG	$3,698	$21	$2,191	($3,628)	($1,354)
CZ10	SDGE	$3,698	$255	$2,191	$2,127	$5,893
CZ11	PGE	$3,789	$327	$15,614	$7,382	$23,549
CZ12	PGE	$3,698	$236	$14,490	$5,437	$20,914
CZ12	SMUD/PGE	$3,698	$772	$14,490	$17,439	$33,302
CZ13	PGE	$3,789	$310	$10,164	$5,378	$16,558
CZ14	SCE/SCG	$3,698	($54)	$11,876	($3,161)	$5,265
CZ14	SDGE	$3,698	$263	$11,876	$4,651	$17,300
CZ15	SCE/SCG	$3,881	$232	$393	($35)	$970
CZ16	PGE	$5,071	$360	$34,043	$13,682	$50,953

Table 31. [1978-1991] DFHP Existing Furnace CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$2,405	$273	$20,184	$12,619	$36,168
CZ02	PGE	$1,670	$12	$9,142	$4,166	$13,857
CZ03	PGE	$1,178	$76	$9,033	$6,011	$14,375
CZ04	PGE	$1,670	$23	$8,160	$3,702	$11,261
CZ04	CPAU	$1,670	$0	$8,160	$711	$711
CZ05	PGE	$1,424	$40	$7,070	$4,285	$11,150
CZ05	PGE/SCG	$1,424	($122)	$7,070	($400)	$3,130
CZ06	SCE/SCG	$1,424	($21)	$2,941	$952	$1,705
CZ07	SDGE	$1,424	$9	$3,046	$1,631	$2,667
CZ08	SCE/SCG	$1,916	($45)	$2,145	($395)	$544
CZ09	SCE/SCG	$1,916	($67)	$2,978	($712)	$712
CZ10	SCE/SCG	$1,916	($50)	$2,606	($357)	$976
CZ10	SDGE	$1,916	$110	$2,606	$3,472	$5,826
CZ11	PGE	$2,162	$155	$9,118	$6,542	$16,502
CZ12	PGE	$1,916	$128	$9,604	$6,434	$16,553
CZ12	SMUD/PGE	$1,916	$506	$9,604	$14,879	$25,269
CZ13	PGE	$2,162	$135	$6,237	$5,170	$12,318
CZ14	SCE/SCG	$1,916	($128)	$4,931	($1,351)	$2,112
CZ14	SDGE	$1,916	$65	$4,931	$3,123	$8,195
CZ15	SCE/SCG	$2,408	($9)	($99)	($653)	($256)
CZ16	PGE	$2,243	$28	$14,397	$4,676	$19,471

Table 32. [1978-1991] Standard Efficiency HPSH CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$3,067	$146	$21,427	$8,941	$34,641
CZ02	PGE	$652	($47)	$10,428	$3,076	$14,864
CZ03	PGE	$514	$33	$8,999	$4,259	$12,882
CZ04	PGE	$652	($10)	$9,984	$3,558	$14,338
CZ04	CPAU	$652	$0	$9,984	$255	$255
CZ05	PGE	$583	($18)	$7,290	$2,586	$10,196
CZ05	PGE/SCG	$583	($199)	$7,290	($2,659)	$1,219
CZ06	SCE/SCG	$583	($24)	$2,450	$215	$956
CZ07	SDGE	$583	$6	$2,539	$898	$1,929
CZ08	SCE/SCG	$721	($57)	$2,111	($896)	$57
CZ09	SCE/SCG	$721	($91)	$3,022	($1,455)	$13
CZ10	SCE/SCG	$721	($71)	$2,672	($1,035)	$390
CZ10	SDGE	$721	$96	$2,672	$2,939	$5,474
CZ11	PGE	$790	$74	$10,682	$5,209	$16,830
CZ12	PGE	$721	$30	$10,747	$4,418	$15,794
CZ12	SMUD/PGE	$721	$573	$10,747	$16,567	$28,332
CZ13	PGE	$790	$72	$7,141	$4,003	$12,047
CZ14	SCE/SCG	$721	($224)	$7,556	($2,880)	$2,930
CZ14	SDGE	$721	$42	$7,556	$3,476	$12,809
CZ15	SCE/SCG	$859	($13)	$71	($639)	($219)
CZ16	PGE	$2,095	($25)	$22,236	$7,529	$37,120

Table 33. [1978-1991] High Efficiency HPSH CARE

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$5,998	$339	$23,092	$8,460	$34,300
CZ02	PGE	$3,606	$57	$9,242	$547	$12,409
CZ03	PGE	$3,422	$111	$6,872	$1,228	$9,907
CZ04	PGE	$3,606	$113	$9,114	$1,472	$12,340
CZ04	CPAU	$3,606	$0	$9,114	($4,595)	($4,595)
CZ05	PGE	$3,514	$58	$4,859	($544)	$7,120
CZ05	PGE/SCG	$3,514	($124)	$4,859	($5,789)	($1,857)
CZ06	SCE/SCG	$3,514	$5	($1,546)	($3,963)	($3,196)
CZ07	SDGE	$3,514	$39	($1,407)	($3,143)	($2,122)
CZ08	SCE/SCG	$3,698	$32	($828)	($3,800)	($2,766)
CZ09	SCE/SCG	$3,698	($0)	$232	($4,336)	($2,784)
CZ10	SCE/SCG	$3,698	$25	$82	($3,803)	($2,290)
CZ10	SDGE	$3,698	$184	$82	$124	$2,631
CZ11	PGE	$3,789	$272	$10,685	$4,725	$16,488
CZ12	PGE	$3,698	$191	$10,023	$3,148	$14,639
CZ12	SMUD/PGE	$3,698	$573	$10,023	$11,680	$23,445
CZ13	PGE	$3,789	$259	$6,612	$3,262	$11,441
CZ14	SCE/SCG	$3,698	($82)	$7,697	($4,629)	$1,311
CZ14	SDGE	$3,698	$195	$7,697	$2,166	$11,452
CZ15	SCE/SCG	$3,881	$133	($1,111)	($2,349)	($1,794)
CZ16	PGE	$5,071	$245	$26,407	$8,685	$38,470

6.3 Utility Rate Schedules

6.3.1 Pacific Gas & Electric

The following pages provide details on the PG&E electricity and natural gas tariffs applied in this study. Table 34 describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of $ 0.03396/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between February 2024 and January 2025.

Table 34. PG&E Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ01	V
CZ02	X
CZ03	T
CZ04	X
CZ05	T
CZ11	R
CZ12	S
CZ13	R
CZ16	Y

The PG&E monthly gas rate in $/therm was applied on a monthly basis according to the rates shown in Table 35. The gas rates were developed based on the latest available gas rate for January 2025 and a curve to reflect how natural gas prices fluctuate with seasonal supply and demand. The seasonal curve was estimated from PG&E's monthly residential tariffs between 2015 and 2024. 12-month curves were created from monthly gas rates for each of the ten years. The ten annual curves were then averaged to arrive at an average normalized annual curve. The baseline and excess transmission charges were found to be consistent over the course of a year and applied for the entire year based on January 2025 rates. The costs presented in Table 35 were then derived by establishing the baseline and excess rates from the latest January 2025 tariff as a reference point, and then using the normalized curve to estimate the cost for the remaining months relative to the January rates. Corresponding CARE tariffs reflect the 20 percent discount per the GL-1 tariff.

Table 35. PG&E Monthly Gas Rate ($/therm)

Month	Total Charge	
	Baseline	Excess
January	$2.63	$3.15
February	$2.64	$3.16
March	$2.41	$2.94
April	$2.24	$2.77
May	$2.21	$2.74
June	$2.23	$2.77
July	$2.26	$2.80
August	$2.36	$2.90
September	$2.42	$2.98
October	$2.52	$3.07
November	$2.63	$3.17
December	$2.70	$3.23

Residential
GAS
Baseline Territories and Quantities [1/]

Effective April 1, 2022 - Present

BASELINE QUANTITIES (Therms **Per Day** Per Dwelling Unit)

Individually Metered

Baseline Territories	Summer (April-October) Effective Apr. 1, 2022	Winter Off-Peak (Nov, Feb, Mar) Effective Nov. 1, 2022	Winter On-Peak (Dec, Jan) Effective Dec. 1, 2022
P	0.39	1.88	2.19
Q	0.56	1.48	2.00
R	0.36	1.24	1.81
S	0.39	1.38	1.94
T	0.56	1.31	1.68
V	0.59	1.51	1.71
W	0.39	1.14	1.68
X	0.49	1.48	2.00
Y	0.72	2.22	2.58

Master Metered

Baseline Territories	Summer (April-October) Effective Apr. 1, 2022	Winter Off-Peak (Nov, Feb, Mar) Effective Nov. 1, 2022	Winter On-Peak (Dec, Jan) Effective Dec. 1, 2022
P	0.29	1.01	1.13
Q	0.56	0.67	0.77
R	0.33	0.87	1.16
S	0.29	0.61	0.65
T	0.56	1.01	1.10
V	0.59	1.28	1.32
W	0.26	0.71	0.87
X	0.33	0.67	0.77
Y	0.52	1.01	1.13

Summer Season: Apr-Oct
Winter Off-Peak: Nov, Feb, Mar
Winter On-Peak: Dec, Jan

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Pacific Gas and Electric Company
U 39 Oakland, California

Revised Cal. P.U.C. Sheet No. 59120-E
Cancelling Revised Cal. P.U.C. Sheet No. 58758-E

ELECTRIC SCHEDULE E-TOU-C Sheet 2
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

RATES: (Cont'd.)

E-TOU-C TOTAL BUNDLED RATES

Total Energy Rates ($ per kWh)	PEAK		OFF-PEAK	
Summer				
Total Usage	$0.60729	(R)	$0.50429	(R)
Baseline Credit (Applied to Baseline Usage Only)	($0.10135)	(R)	($0.10135)	(R)
Winter				
Total Usage	$0.49312	(R)	$0.46312	(R)
Baseline Credit (Applied to Baseline Usage Only)	($0.10135)	(R)	($0.10135)	(R)
Delivery Minimum Bill Amount ($ per meter per day)	$0.39167			
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	($58.23)	(R)		

Total bundled service charges shown on customer's bills are unbundled according to the component rates shown below. Where the delivery minimum bill amount applies, the customer's bill will equal the sum of (1) the delivery minimum bill amount plus (2) for bundled service, the generation rate times the number of kWh used. For revenue accounting purposes, the revenues from the delivery minimum bill amount will be assigned to the Transmission, Transmission Rate Adjustments, Reliability Services, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges, Energy Cost Recovery Amount, Wildfire Fund Charge, and New System Generation Charges based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.

(Continued)

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Decision

Issued by
Shilpa Ramaiya
Vice President
Regulatory Proceedings and Rates

Submitted December 30, 2024
Effective January 1, 2025
Resolution

Pacific Gas and Electric Company
U 39 Oakland, California

Cancelling Revised Cal. P.U.C. Sheet No. 59121-E
Revised Cal. P.U.C. Sheet No. 58759-E

ELECTRIC SCHEDULE E-TOU-C Sheet 3
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

RATES: (Cont'd.)

UNBUNDLING OF E-TOU-C TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK		OFF-PEAK	
Generation:				
Summer (all usage)	$0.24730	(I)	$0.16430	(I)
Winter (all usage)	$0.18725	(I)	$0.16057	(I)
Distribution:**				
Summer (all usage)	$0.24056	(I)	$0.22056	(I)
Winter (all usage)	$0.18645	(I)	$0.18313	(I)

Conservation Incentive Adjustment (Baseline Usage)	($0.03733)	(I)
Conservation Incentive Adjustment (Over Baseline Usage)	$0.06402	(I)
Transmission* (all usage)	$0.05122	(I)
Transmission Rate Adjustments* (all usage)	($0.01509)	(R)
Reliability Services* (all usage)	$0.00032	(I)
Public Purpose Programs (all usage)	$0.02644	(R)
Nuclear Decommissioning (all usage)	($0.00013)	(I)
Competition Transition Charges (all usage)	($0.00072)	(R)
Energy Cost Recovery Amount (all usage)	$0.00001	(I)
Wildfire Fund Charge (all usage)	$0.00595	(I)
New System Generation Charge (all usage)**	$0.00574	(R)
Wildfire Hardening Charge (all usage)	$0.00494	
Recovery Bond Charge (all usage)	$0.00650	
Recovery Bond Credit (all usage)	($0.00650)	
Bundled Power Charge Indifference Adjustment (all usage)***	($0.02327)	(R)

* Transmission, Transmission Rate Adjustments and Reliability Service charges are combined for presentation on customer bills.
** Distribution and New System Generation Charges are combined for presentation on customer bills.
*** Direct Access, Community Choice Aggregation and Transitional Bundled Service Customers pay the applicable Vintaged Power Charge Indifference Adjustment. Generation and Bundled PCIA are combined for presentation on bundled customer bills.

(Continued)

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Pacific Gas and Electric Company
U 39 Oakland, California

Cancelling Revised Cal. P.U.C. Sheet No. 59109-E
Cancelling Revised Cal. P.U.C. Sheet No. 58755-E

ELECTRIC SCHEDULE E-ELEC Sheet 2
RESIDENTIAL TIME-OF-USE (ELECTRIC HOME)
SERVICE FOR CUSTOMERS WITH QUALIFYING ELECTRIC TECHNOLOGIES

RATES:(Cont'd.)

Direct Access (DA) and Community Choice Aggregation (CCA) charges shall be calculated in accordance with the paragraph in this rate schedule titled Billing.

TOTAL BUNDLED RATES

Base Services Charge ($ per meter per day)	$0.49281						
Total Energy Rates ($ per kWh)	PEAK		PART-PEAK		OFF-PEAK		
Summer Usage	$0.60728	(R)	$0.44540	(R)	$0.38872	(R)	
Winter Usage	$0.37577	(R)	$0.35368	(R)	$0.33982	(R)	
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	($58.23)	(R)					

Total bundled service charges shown on a customer's bills are unbundled according to the component rates shown below.

UNBUNDLING OF TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK		PART-PEAK		OFF-PEAK	
Generation:						
Summer Usage	$0.31659	(I)	$0.21748	(I)	$0.17238	(I)
Winter Usage	$0.15446	(I)	$0.13449	(I)	$0.12114	(I)
Distribution:**						
Summer Usage	$0.23528	(I)	$0.17251	(I)	$0.16093	(I)
Winter Usage	$0.16590	(I)	$0.16378	(I)	$0.16327	(I)
Transmission* (all usage)	$0.05122	(I)	$0.05122	(I)	$0.05122	(I)
Transmission Rate Adjustments* (all usage)	($0.01509)	(R)	($0.01509)	(R)	($0.01509)	(R)
Reliability Services* (all usage)	$0.00032	(I)	$0.00032	(I)	$0.00032	(I)
Public Purpose Programs (all usage)	$0.02644	(R)	$0.02644	(R)	$0.02644	(R)
Nuclear Decommissioning (all usage)	($0.00013)	(I)	($0.00013)	(I)	($0.00013)	(I)
Competition Transition Charges (all usage)	($0.00072)	(R)	($0.00072)	(R)	($0.00072)	(R)
Energy Cost Recovery Amount (all usage)	$0.00001	(I)	$0.00001	(I)	$0.00001	(I)
Wildfire Fund Charge (all usage)	$0.00595	(I)	$0.00595	(I)	$0.00595	(I)
New System Generation Charge (all usage)**	$0.00574	(R)	$0.00574	(R)	$0.00574	(R)
Wildfire Hardening Charge (all usage)	$0.00494		$0.00494		$0.00494	
Recovery Bond Charge (all usage)	$0.00650		$0.00650		$0.00650	
Recovery Bond Credit (all usage)	($0.00650)		($0.00650)		($0.00650)	
Bundled Power Charge Indifference Adjustment (all usage)***	($0.02327)	(R)	($0.02327)	(R)	($0.02327)	(R)

* Transmission, Transmission Rate Adjustments and Reliability Service charges are combined for presentation on customer bills.
** Distribution and New System Generation Charges are combined for presentation on customer bills.
*** Direct Access, Community Choice Aggregation and Transitional Bundled Service Customers pay the applicable Vintaged Power Charge Indifference Adjustment. Generation and Bundled PCIA are combined for presentation on bundled customer bills.

(Continued)

Advice 7469-E
Decision

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Vice President
Regulatory Proceedings and Rates

Submitted December 30, 2024
Effective January 1, 2025
Resolution

Pacific Gas and Electric Company
U 39 San Francisco, California

Original Cal. P.U.C. Sheet No. 54738-E

ELECTRIC SCHEDULE E-ELEC Sheet 3 (N)
RESIDENTIAL TIME-OF-USE (ELECTRIC HOME) (N)
SERVICE FOR CUSTOMERS WITH QUALIFYING ELECTRIC TECHNOLOGIES

SPECIAL CONDITIONS:

1. TIME PERIODS: Times of the year and times of the day are defined as follows: (N)

   All Year:

   Peak: 4:00 p.m. to 9:00 p.m. every day including weekends and holidays.

   Partial-Peak: 3:00 p.m. to 4:00 p.m. and 9:00 p.m. to 12:00 a.m. every day including weekends and holidays.

   Off-Peak: All other hours.

2. SEASONAL CHANGES: The summer season is June 1 through September 30 and the winter season is October 1 through May 31. When billing includes use in both the summer and winter periods, charges will be prorated based upon the number of days in each period.

3. ADDITIONAL METERS: If a residential dwelling unit is served by more than one electric meter, the customer must designate which meter is the primary meter and which is (are) the additional meter(s).

4. BILLING: A customer's bill is calculated based on the option applicable to the customer.

   Bundled Service Customers receive generation and delivery services solely from PG&E. The customer's bill is based on the Unbundling of Total Rates set forth above.

   Transitional Bundled Service (TBS) Customers take TBS as prescribed in Rules 22.1 and 23.1, or take PG&E bundled service prior to the end of the six (6) month advance notice period required to elect PG&E bundled service as prescribed in Rules 22.1 and 23.1. TBS customers shall pay all charges shown in the Unbundling of Total Rates except for the Bundled Power Charge Indifference Adjustment and the generation charge. TBS customers shall also pay for their applicable Vintaged Power Charge Indifference Adjustment provided in the table below, and the short-term commodity prices as set forth in Schedule TBCC. (N)

(Continued)

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Decision	D.21-11-016	**Meredith Allen**	Effective	December 1, 2022
		Vice President, Regulatory Affairs	Resolution	

Pacific Gas and Electric Company
U 39 Oakland, California

Revised Cal. P.U.C. Sheet No. 59329-E
Cancelling Revised Cal. P.U.C. Sheet No. 59086-E

ELECTRIC SCHEDULE D-CARE Sheet 1
LINE-ITEM DISCOUNT FOR CALIFORNIA ALTERNATE RATES FOR ENERGY (CARE) CUSTOMERS

APPLICABILITY: This schedule is applicable to single-phase and polyphase residential service in single-family dwellings and in flats and apartments separately metered by PG&E and domestic submetered tenants residing in multifamily accommodations, mobilehome parks and to qualifying recreational vehicle parks and marinas and to farm service on the premises operated by the person whose residence is supplied through the same meter, where the applicant qualifies for California Alternate Rates for Energy (CARE) under the eligibility and certification criteria set forth in Electric Rule 19.1. CARE service is available on Schedules E-1, E-TOU-B, E-TOU-C, E-TOU-D, EV2, E-ELEC, EM, ES, ESR, ET and EM-TOU.

TERRITORY: This rate schedule applies everywhere PG&E provides electric service.

RATES: Customers taking service on this rate schedule whose otherwise applicable rate schedule has no Delivery Minimum Bill Amount (Schedule E-ELEC) will receive a CARE percentage discount of 38.351% (R) on their total bundled charges (except for the California Climate Credit, which will not be discounted). Customers taking service on this rate schedule whose otherwise applicable rate schedule has a Delivery Minimum Bill Amount (all other schedules) will receive a CARE percentage discount ("A" or "C" below) on their total bundled charges less charges from which they are exempt (Wildfire Fund Charge, Recovery Bond Charge, Recovery Bond Credit, and the CARE surcharge portion of the public purpose program charge used to fund the CARE discount) on their otherwise applicable rate schedule (except for the California Climate Credit, which will not be discounted) and also will receive a percentage discount ("B" or "D" below) on the delivery minimum bill amount, if applicable. The CARE discount will be calculated for direct access and community choice aggregation customers based on the total charges as if they were subject to bundled service rates. Discounts will be applied as a reduction to distribution charges. These conditions also apply to master-metered customers and to qualified sub-metered tenants where the master-meter customer is jointly served under PG&E's Rate Schedule D-CARE and either Schedule EM, ES, ESR, ET, or EM-TOU.

For master-metered customers where one or more of the submetered tenants qualifies for CARE rates under the eligibility and certification criteria set forth in Rule 19.1, 19.2, or 19.3, the CARE discount is equal to a percentage ("C" below) of the total bundled charges, multiplied by the number of CARE units divided by the total number of units. In addition, master-metered customers eligible for D-CARE will receive a percentage discount ("D" below) on the delivery minimum bill amount, if applicable.

It is the responsibility of the master-metered customer to advise PG&E within 15 days following any change in the number of dwelling units and/or any decrease in the number of qualifying CARE applicants that results when such applicants move out of their submetered or non-submetered dwelling unit, or submetered permanent-residence RV or permanent-residence boat.

(Continued)

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Pacific Gas and Electric Company
U 39 Oakland, California

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ELECTRIC SCHEDULE D-CARE Sheet 2
LINE-ITEM DISCOUNT FOR CALIFORNIA ALTERNATE RATES FOR ENERGY (CARE) CUSTOMERS

RATES: (Cont'd)

A.	D-CARE Discount:	35.000	% (Percent)	(I)
B.	Delivery Minimum Bill Discount:	50.000	% (Percent)	
C.	Master-Meter D-CARE Discount:	35.000	% (Percent)	(I)
D.	Master-Meter Delivery Minimum Bill Discount:	50.000	% (Percent)	

SPECIAL CONDITIONS:

1. OTHERWISE APPLICABLE SCHEDULE: The Special Conditions of the Customer's otherwise applicable rate schedule will apply to this schedule.

2. ELIGIBILITY: To be eligible to receive D-CARE the applicant must qualify under the criteria set forth in PG&E's Electric Rules 19.1, 19.2, and 19.3 and meet the certification requirements thereof to the satisfaction of PG&E. Qualifying Direct Access, Community Choice Aggregation Service, and Transitional Bundled Service customers are also eligible to take service on Schedule D-CARE. Applicants may qualify for D-CARE at their primary residence only. Customers or sub-metered tenants participating in the Family Electric Rate Assistance (FERA) program cannot concurrently participate in the CARE program.

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6.3.2 Southern California Edison

The following pages provide details on the SCE electricity tariffs applied in this study. Table describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of $ 0.01532/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between February 2024 and January 2025.

Table 36. SCE Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ06	6
CZ08	8
CZ09	9
CZ10	10
CZ14	14
CZ15	15

Summer Daily Allocations (June through September)

Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	17.2	17.9
6	11.4	8.8
8	12.6	9.8
9	16.5	12.4
10	18.9	15.8
13	22.0	24.6
14	18.7	18.3
15	46.4	24.1
16	14.4	13.5

Winter Daily Allocations (October through May)

Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	18.7	29.1
6	11.3	13.0
8	10.6	12.7
9	12.3	14.3
10	12.5	17.0
13	12.6	24.3
14	12.0	21.3
15	9.9	18.2
16	12.6	23.1

Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 12 (T)

SPECIAL CONDITIONS

1. Applicable rate time periods are defined as follows:

Option 4-9 PM, Option 4-9 PM-CPP, Option PRIME, Option PRIME-CPP : (T)

TOU Period	Weekdays		Weekends and Holidays	
	Summer	Winter	Summer	Winter
On-Peak	4 p.m. - 9 p.m.	N/A	N/A	N/A
Mid-Peak	N/A	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.
Off-Peak	All other hours	9 p.m. - 8 a.m.	All other hours	9 p.m. - 8 a.m.
Super-Off-Peak	N/A	8 a.m. - 4 p.m.	N/A	8 a.m. - 4 p.m.
CPP Event Period	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	N/A	N/A

Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 89278-E
Cancelling Revised Cal. PUC Sheet No. 88856-E

Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 2

RATES

Customers receiving service under this Schedule will be charged the applicable rates under Option 4-9 PM, Option 4-9 PM-CPP, Option 5-8 PM, Option 5-8 PM-CPP, Option PRIME, Option PRIME-CPP Option A, Option A-CPP, Option B, or Option B-CPP, as listed below. CPP Event Charges will apply to all energy usage during CPP Event Energy Charge periods and CPP Non-Event Energy Credits will apply as a reduction on CPP Non-Event Energy Credit Periods during Summer Season days, 4:00 p.m. to 9:00 p.m., as described in Special Conditions 1 and 3, below:

		Delivery Service Total[1]	Generation[2] UG***	Generation[2] DWREC[3]
Option 4-9 PM / Option 4-9 PM-CPP				
Energy Charge - $/kWh				
	Summer Season - On-Peak	0.35546 (I)	0.24264 (R)	0.00000
	Mid-Peak	0.35546 (I)	0.12948 (R)	0.00000
	Off-Peak	0.30374 (I)	0.06976 (R)	0.00000
	Winter Season - Mid-Peak	0.35546 (I)	0.17237 (R)	0.00000
	Off-Peak	0.30374 (I)	0.09602 (R)	0.00000
	Super-Off-Peak	0.28513 (I)	0.07779 (R)	0.00000
Baseline Credit**** - $/kWh		(0.09514) (I)	0.00000	
Fixed Recovery Charge - $/kWh		0.00198 (I)		
MCAM Charge[5] - $/kWh		0.00160 (I)		
Basic Charge - $/day				
	Single-Family Residence	0.031		
	Multi-Family Residence	0.024		
Minimum Charge** - $/day				
	Single Family Residence	0.346		
	Multi-Family Residence	0.346		
Minimum Charge (Medical Baseline)** - $/day				
	Single Family Residence	0.173		
	Multi-Family Residence	0.173		
California Climate Credit[4]		(56.00) (R)		
California Alternate Rates for Energy Discount - %		100.00*		
Family Electric Rate Assistance Discount - %		100.00		
Option 4-9 PM-CPP				
CPP Event Energy Charge - $/kWh			0.80000	
Summer CPP Non-Event Credit On-Peak Energy Credit - $/kWh			(0.15170)	
Maximum Available Credit - $/kWh*****				
	Summer Season		(0.54821) (R)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
** The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.
*** The ongoing Competition Transition Charge CTC of ($0.00058) per kWh is recovered in the UG component of Generation. (R)
**** The Baseline Credit applies up to 100% of the Baseline Allocation, regardless of Time-of-Use time period. Additional Baseline Allocations apply for Customers with Heat Pump Water Heaters served under this Option. The Baseline Allocations are set forth in Preliminary Statement, Part H.
***** The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs.
1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.
2 Generation = The Gen rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.
3 DWREC = Department of Water Resources (DWR) Energy Credit – For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.
5 The Modified Cost Allocation Mechanism (MCAM) charge recovers the net cost associated with system reliability procurement ordered by the CPUC that SCE has procured on behalf of customers whose generation services are provided by certain Electric Service Providers or Community Choice Aggregators.

(Continued)

(To be inserted by utility)
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Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 89282-E
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Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 6

RATES (Continued)

		Delivery Service Total[1]	Generation[2] UG**	Generation[2] DWREC[3]
Option PRIME / Option PRIME-CPP				
Energy Charge - $/kWh/Meter/Day				
Summer Season				
	On-Peak	0.28716 (I)	0.28317 (R)	0.00000
	Mid-Peak	0.28716 (I)	0.10077 (R)	0.00000
	Off-Peak	0.20039 (I)	0.06728 (R)	0.00000
Winter Season				
	Mid-Peak	0.29246 (I)	0.24759 (R)	0.00000
	Off-Peak	0.19215 (I)	0.05686 (R)	0.00000
	Super-Off-Peak	0.19215 (I)	0.05686 (R)	0.00000
Fixed Recovery Charge - $/kWh		0.00198 (I)		
MCAM Charge[5] - $/kWh		0.00160 (I)		
Basic Charge - $/Meter/Day		0.539 (R)		
EV Meter Credit (Separately Metered EV Option) - $/Meter/Day		(0.408) (I)		
EV Submeter Credit - $/Meter/Day		(0.139) (I)		
California Climate Credit[4]		(56.00) (R)		
California Alternate Rates for Energy Discount - %		100.00*		
Family Electric Rate Assistance Discount - %		100.00		
Medical Line Item Discount - %		100.000		
Option PRIME-CPP				
CPP Event Energy Charge - $/kWh			0.80000	
Summer CPP Non-Event Credit				
On-Peak Energy Credit - $/kWh			(0.15170)	
Maximum Available Credit - $/kWh****				
	Summer Season		(0.54821) (R)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
** The ongoing Competition Transition Charge (CTC) of ($0.00058) per kWh is recovered in the UG component of Generation. (R)
**** The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs.
1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.
2 Generation = The Gen rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.
3 DWREC = Department of Water Resources (DWR) Energy Credit – For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.
5 The Modified Cost Allocation Mechanism (MCAM) charge recovers the net cost associated with system reliability procurement ordered by the CPUC that SCE has procured on behalf of customers whose generation services are provided by certain Electric Service Providers or Community Choice Aggregators.

(Continued)

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6C9

Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 89277-E
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Schedule D-CARE Sheet 1
CALIFORNIA ALTERNATE RATES FOR ENERGY
DOMESTIC SERVICE

APPLICABILITY

Applicable to domestic service to California Alternate Rates for Energy (CARE) households residing in a permanent Single-Family Accommodation or Multifamily Accommodation where the customer meets all the Special Conditions of this Schedule. Customers enrolled in the CARE program are not eligible for the Family Electric Rate Assistance (FERA) program.

Pursuant to Special Condition 12 herein, customers receiving service under this Schedule are eligible to receive the California Climate Credit as shown in the Rates section below.

TERRITORY

Within the entire territory served.

RATES

The applicable charges set forth in Schedule D shall apply to Customers served under this Schedule.

CARE Discount:

A 32.5 percent discount is applied to a CARE Customer's bill prior to the application of the Public Utilities Commission Reimbursement Fee (PUCRF) and any applicable user fees, taxes, and late payment charges. CARE Customers are required to pay the PUCRF and any applicable user fees, taxes, and late payment charges in full. In addition, CARE Customers are exempt from paying the CARE Surcharge of $0.01435 per kWh, the Wildfire Fund Non-Bypassable Charge of $0.00595 per kWh, and the Fixed Recovery Charge of $0.00198 per kWh.. (I) (I) (I)

(Continued)

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1H14

6.3.3 Southern California Gas

Following are the SoCalGas natural gas tariffs applied in this study. Table 37 describes the baseline territories that were assumed for each climate zone.

Table 37. SoCalGas Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ05	2
CZ06	1
CZ08	1
CZ09	1
CZ10	1
CZ14	2
CZ15	1

The SoCalGas monthly gas rate in $/therm applied in this analysis is shown in Table 38. The gas rates were developed based on the latest available gas rate for January 2025 and a curve to reflect how natural gas prices fluctuate with seasonal supply and demand. The seasonal curve was estimated from SoCalGas's monthly residential tariffs between 2015 and 2024. 12-month curves were created from monthly gas rates for each of the ten years. The ten annual curves were then averaged to arrive at an average normalized annual curve. Long-term historical natural gas rate data was only available for SoCalGas' procurement charges.[8] The baseline and excess transmission charges were found to be consistent over the course of a year and applied for the entire year based on January 2025 rates. The costs presented in Table 38 were then derived by establishing the baseline and excess rates from the latest January 2025 tariff as a reference point, and then using the normalized curve to estimate the cost for the remaining months relative to the January rates. CARE tariffs reflect the 20 percent discount per the GR tariff.

[8] The SoCalGas procurement and transmission charges were obtained from the following site: https://www.socalgas.com/for-your-business/energy-market-services/gas-prices RES2023.xlsx (live.com)

Table 38. SoCalGas Monthly Gas Rate ($/therm)

Month	Procurement Charge	Transportation Charge		Total Charge	
		Baseline	Excess	Baseline	Excess
January	$0.45	$0.98	$1.40	$1.43	$1.85
February	$0.31	$0.98	$1.40	$1.29	$1.71
March	$0.26	$0.98	$1.40	$1.24	$1.66
April	$0.21	$0.98	$1.40	$1.19	$1.62
May	$0.22	$0.98	$1.40	$1.20	$1.62
June	$0.25	$0.98	$1.40	$1.23	$1.65
July	$0.26	$0.98	$1.40	$1.24	$1.66
August	$0.29	$0.98	$1.40	$1.27	$1.70
September	$0.27	$0.98	$1.40	$1.25	$1.67
October	$0.26	$0.98	$1.40	$1.24	$1.66
November	$0.29	$0.98	$1.40	$1.27	$1.69
December	$0.33	$0.98	$1.40	$1.31	$1.73

6.3.4 San Diego Gas & Electric

Following are the SDG&E electricity and natural gas tariffs applied in this study. Table 39 describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of $ 0.01837/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between February 2024 and January 2025.

Table 39. SDG&E Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ07	Coastal
CZ10	Inland
CZ14	Mountain

The SDG&E monthly gas rate in $/therm was applied on a monthly basis according to the rates shown in Table 40. The gas rates were developed based on the latest available gas rate for January 2025 and a curve to reflect how natural gas prices fluctuate with seasonal supply and demand. The seasonal curve was estimated from SDG&E's monthly residential tariffs between 2015 and 2024. 12-month curves were created from monthly gas rates for each of the ten years. The ten annual curves were then averaged to arrive at an average normalized annual curve. The baseline and excess transmission charges were found to be consistent over the course of a year and applied for the entire year based on January 2025 rates. The costs presented in Table 40 were then derived by establishing the baseline and excess rates from the latest January 2025 tariff as a reference point, and then using the normalized curve to estimate the cost for the remaining months relative to the January rates. CARE tariffs reflect the 20 percent discount per the G-CARE tariff.

Table 40. SDG&E Monthly Gas Rate ($/therm)

Month	Total Charge	
	Baseline	Excess
January	$2.07	$2.36
February	$2.01	$2.30
March	$1.93	$2.22
April	$1.86	$2.16
May	$1.88	$2.18
June	$1.94	$2.24
July	$1.95	$2.25
August	$2.02	$2.32
September	$1.97	$2.27
October	$1.94	$2.24
November	$1.97	$2.27
December	$2.07	$2.37

Baseline Usage: The following quantities of gas used in individually metered residences are to be billed at the baseline rates:

All Customers:	Daily Therm Allowance
Summer (May to Oct)	0.359
Winter On-Peak (Dec, Jan & Feb)	1.233
Winter Off-Peak (Nov, Mar, & Apr)	0.692

San Diego Gas & Electric Company
San Diego, California

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Sheet 2

SCHEDULE TOU-DR1
RESIDENTIAL TIME-OF-USE

RATES

Total Rates:

Description – TOU DR1	UDC Total Rate	DWR BC + WF-NBC	EECC Rate	Total Rate
Summer:				
On-Peak	0.28222	0.00561	0.41736	0.70519
Off-Peak	0.28222	0.00561	0.18792	0.47575
Super Off-Peak	0.28222	0.00561	0.06741	0.35524
Winter:				
On-Peak	0.41439	0.00561	0.14115	0.56115
Off-Peak	0.41439	0.00561	0.07928	0.49928
Super Off-Peak	0.41439	0.00561	0.06133	0.48133
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.10543)			(0.10543)
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.10543)			(0.10543)
Minimum Bill ($/day)	0.392			0.392

Description – TOU DR1-CARE	UDC Total Rate	DWR BC + WF-NBC	EECC Rate	Total Rate	Total Effective Care Rate	
Summer – CARE Rates:						
On-Peak	0.28222	0.00000	0.41736	0.69958	0.46249	R
Off-Peak	0.28222	0.00000	0.18792	0.47014	0.30762	R
Super Off-Peak	0.28222	0.00000	0.06741	0.34963	0.22627	R
Winter – CARE Rates:						
On-Peak	0.41439	0.00000	0.14115	0.55554	0.36526	R
Off-Peak	0.41439	0.00000	0.07928	0.49367	0.32350	R
Super Off-Peak	0.41439	0.00000	0.06133	0.47572	0.31138	R
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.10543)			(0.10543)	(0.07117)	I
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.10543)			(0.10543)	(0.07117)	I
Minimum Bill ($/day)	0.196			0.196	0.196	

Note:
(1) Total Rates consist of UDC, Schedule DWR-BC (Department of Water Resources Bond Charge), Schedule WF-NBC (CA Wildfire Fund charge) and Schedule EECC (Electric Energy Commodity Cost) rates. EECC rates are applicable to bundled customers only. See Special Condition 16 for PCIA (Power Charge Indifference Adjustment) recovery.
(2) Total Rates presented are for customers that receive commodity supply and delivery service from Utility.
(3) DWR-BC and WF-NBC charges do not apply to CARE customers.
(4) As identified in the rates tables, customer bills will also include line-item summer and winter credits for usage up to 130% of baseline to provide the rate capping benefits adopted by Assembly Bill 1X and Senate Bill 695.
(5) WF-NBC rate is 0.00561 + DWR-BC Bond Charge is 0.00000 .

(Continued)

2H10
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Dan Skopec
Senior Vice President
Regulatory Affairs

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SCHEDULE TOU-DR1

Sheet 5

RESIDENTIAL TIME-OF-USE

Minimum Bill

The minimum bill to recover Distribution and TRAC costs is calculated as the minimum bill charge of $0.402 per day times the number of days in the billing cycle with a 50% discount applied for CARE or Family Electric Rate Assistance Program (FERA) customers resulting in a minimum bill charge of $0.201 per day.

Rate Components

The Utility Distribution Company Total Rates (UDC Total) shown above are comprised of the following components (if applicable): (1) Transmission (Trans) Charges, (2) Distribution (Distr) Charges, (3) Public Purpose Program (PPP) Charges, (4) Nuclear Decommissioning (ND) Charge, (5) Ongoing Competition Transition Charges (CTC), (6) Local Generation Charge (LGC), (7) Reliability Services (RS), and (8) the Total Rate Adjustment Component (TRAC).

Customers taking service under this Schedule may be eligible for a California Alternate Rates for Energy (CARE) discount on their bill, if they qualify to receive service under the terms and conditions of Schedule E-CARE. In addition, qualified CARE customers are exempt from paying the CARE surcharge of $0.01230 Per kWh. Customers that are eligible and receive both CARE and medical baseline will be given the additional medical baseline allotment for which they qualify and will receive the total effective CARE and medical baseline discounts identified in Schedule E-CARE.

Franchise Fee Differential

A Franchise Fee Differential of 5.78% will be applied to the monthly billings calculated under this Schedule for all customers within the corporate limits of the City of San Diego. Such Franchise Fee Differential shall be so indicated and added as a separate item to bills rendered to such customers.

Time Periods

All time periods listed are applicable to local time. The definition of time will be based upon the date service is rendered.

TOU Periods – Weekdays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	6:00 a.m. – 4:00 p.m.; 9:00 p.m. - midnight	6:00 a.m. – 4:00 p.m. Excluding 10:00 a.m. – 2:00 p.m. in March and April; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m. 10:00 a.m. – 2:00 p.m. in March and April
TOU Period – Weekends and Holidays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

Seasons: Summer June 1 – October 31
Winter November 1 – May 31

Schedule EV-TOU-5 - DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES provides domestic residential service for customers who own qualifying electric vehicles. Effective 10/1/2024

SCHEDULE EV-TOU-5										Schedule WF-NBC + DWR-BC Rate	Schedule EECC Rate	Total Electric Rate
Energy Charges ($/kWh)		Transm	Distr	PPP	ND	CTC	LGC	RS	TRAC	UDC Total			
Summer													
On-Peak		0.05840	0.18330	0.01654	0.00007	0.00054	0.02516	0.00001	0.00000	0.28402	0.00561	0.38826	0.67789
Off-Peak		0.05840	0.18330	0.01654	0.00007	0.00054	0.02516	0.00001	0.00000	0.28402	0.00561	0.14305	0.43268
Super Off-Peak		0.00000	0.01496	0.01654	0.00007	0.00054	0.02516	0.00001	0.00000	0.05728	0.00561	0.06741	0.13030
Winter													
On-Peak		0.05840	0.18330	0.01654	0.00007	0.00054	0.02516	0.00001	0.00000	0.28402	0.00561	0.16516	0.45479
Off-Peak		0.05840	0.18330	0.01654	0.00007	0.00054	0.02516	0.00001	0.00000	0.28402	0.00561	0.11850	0.40813
Super Off-Peak		0.00000	0.01496	0.01654	0.00007	0.00054	0.02516	0.00001	0.00000	0.05728	0.00561	0.06133	0.12422
Other Charges/Discounts													
Basic Service Fee	($/month)	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00			16.00

Notes:
1) The total rates presented reflect the UDC rates associated with service under Schedule EV-TOU-5 and the generation rates associated with Schedule EECC, in addition to the rates associated with Schedules DWR-BC and WF-NBC. The UDC rate-by-rate components presented are associated with service under Schedule EV-TOU-5 as presented in the utility's tariff book.
2) Unbundled customers are those who take generation from other providers, such as Direct Access (DA) or Community Choice Aggregation (CCA). Unbundled customers do not pay SDG&E's commodity rates. The Total Energy Charge for an unbundled customer includes UDC, WF-NBC, DWR-BC and Power Charge Indifference Adjustment (PCIA) rates. PCIA rates by vintage are included below. Please see Schedules DA-CRS or CCA-CRS for more information regarding PCIA rates.

SCHEDULE EV-TOU-5

Sheet 4

COST-BASED DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES

Notes: Transmission Energy charges include the Transmission Revenue Balancing Account Adjustment (TRBAA) of $(0.00289) per kWh and the Transmission Access Charge Balancing Account Adjustment (TACBAA) of $(0.01656) per kWh. PPP Energy charges includes Low Income PPP rate (LI-PPP) $0.01515/kWh, Non-low Income PPP rate (Non-LI-PPP) $0.00031/kWh (pursuant to PU Code Section 399.8, the Non-LI-PPP rate may not exceed January 1, 2000 levels), and California Solar Initiative rate (CSI) of $(0.00075)/kWh and Self-Generation Incentive Program rate (SGIP) $0.00149/kWh. The basic service fee of $16 per month is applied to a customer's bill and a 50% discount is applied for CARE, Medical Baseline, or Family Electric Rate Assistance Program (FERA) customers resulting in their basic service fees to be $8 per month.

Rate Components

The Utility Distribution Company Total Rates (UDC Total) shown above are comprised of the following components (if applicable): (1) Transmission (Trans) Charges, (2) Distribution (Distr) Charges, (3) Public Purpose Program (PPP) Charges, (4) Nuclear Decommissioning (ND) Charge, (5) Ongoing Competition Transition Charges (CTC), (6) Local Generation Charge (LGC), (7) Reliability Services (RS), and (8) the Total Rate Adjustment Component (TRAC).

Certain Direct Access customers are exempt from the TRAC, as defined in Rule 1 – Definitions.

Franchise Fee Differential

A Franchise Fee Differential of 5.78% will be applied to the monthly billings calculated under this schedule for all customers within the corporate limits of the City of San Diego. Such Franchise Fee Differential shall be so indicated and added as a separate item to bills rendered to such customers.

Time Periods:

All time periods listed are applicable to actual "clock" time)

TOU Period – Weekdays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	6:00 a.m. – 4:00 p.m.; 9:00 p.m. – midnight	6:00 a.m. – 4:00 p.m. Excluding 10:00 a.m.–2:00 p.m.in March and April; 9:00 p.m. - midnight
Super-Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m. 10:00 a.m. – 2:00 p.m. in March and April

TOU Period – Weekends and Holidays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	2:00 p.m. – 4:00 p.m.; 9:00 p.m. – midnight	2:00 p.m. – 4:00 p.m. 9:00 p.m. - midnight
Super-Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

Seasons:

Summer June 1 – October 31

Winter November 1 – May 31

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 62755-E
Canceling Revised Cal. P.U.C. Sheet No. 35718-E

SCHEDULE E-CARE Sheet 1

CALIFORNIA ALTERNATE RATES FOR ENERGY

APPLICABILITY

This schedule provides a California Alternate Rates for Energy (CARE) discount to each of the following types of customers listed below that meet the requirements for CARE eligibility as defined in Rule 1, Definitions, and herein, and is taken in conjunction with the customer's otherwise applicable service schedule.

1) Customers residing in a permanent single-family accommodation, separately metered by the Utility.

2) Multi-family dwelling units and mobile home parks supplied through one meter on a single premises where the individual unit is submetered.

3) Non-profit group living facilities.

4) Agricultural employee housing facilities.

TERRITORY

Within the entire territory served by the Utility.

DISCOUNT

1) Residential CARE:

Pursuant to D.24-05-028, the applicable CARE discount rate is to be between 30% and 35%, with the intended CARE discount rate to be 35% for SDG&E, specifically, applied as a fixed CARE line-item discount. T N N

In addition to the CARE line-item discount, the total effective CARE discount consists of: (a) exemptions from paying the CARE Surcharge, Department of Water Resources Bond Charge (DWR-BC), California Wildfire Fund Charge (WF-NBC), Vehicle-Grid Integration (VGI) costs, and California Solar Initiative (CSI) and (b) a 50% minimum bill relative to Non-CARE.

(Continued)

1H6
Advice Ltr. No. 4572-E-A
Decision No. D.24-05-028

Issued by
Dan Skopec
Senior Vice President
Regulatory Affairs

Submitted Jan 24, 2025
Effective Jan 1, 2025
Resolution No.

6.3.5 City of Palo Alto Utilities

Following are the CPAU electricity and natural gas tariffs applied in this study. The CPAU monthly gas rate in $/therm was applied on a monthly basis according to the rates shown in Table 41. The gas rates were developed based on the latest available gas rate for January 2025 and a curve to reflect how natural gas prices fluctuate with seasonal supply and demand. The seasonal curve was estimated from CPAU's monthly residential tariffs between 2018 and 2024. 12-month curves were created from monthly gas rates for each of the seven years. The seven annual curves were then averaged to arrive at an average normalized annual curve. The baseline and excess transmission charges were found to be consistent over the course of a year and applied for the entire year based on January 2025 rates. The costs presented in Table 41 were then derived by establishing the baseline and excess rates from the latest January 2025 tariff as a reference point and then using the normalized curve to estimate the cost for the remaining months relative to the January rates. The monthly service charge applied was $16.93 per month per the January 2025 G-1 tariff.

Table 41. CPAU Monthly Gas Rate ($/therm)

Month	G1 Volumetric Total Baseline	G1 Volumetric Total Excess
January	$1.74	$3.02
February	$1.33	$2.53
March	$1.24	$2.43
April	$1.21	$2.39
May	$1.21	$2.39
June	$1.23	$2.42
July	$1.31	$2.64
August	$1.37	$2.71
September	$1.36	$2.71
October	$1.38	$2.72
November	$1.45	$2.80
December	$1.57	$2.96

RESIDENTIAL ELECTRIC SERVICE

UTILITY RATE SCHEDULE E-1

A. APPLICABILITY:

This Rate Schedule applies to separately metered single-family residential dwellings receiving Electric Service from the City of Palo Alto Utilities.

B. TERRITORY:

This rate schedule applies everywhere the City of Palo Alto provides Electric Service.

C. UNBUNDLED RATES:

Per kilowatt-hour (kWh)	Commodity	Distribution	Public Benefits	Total
Tier 1 usage	$ 0.10270	$ 0.08642	$ 0.00549	$ 0.19461
Tier 2 usage Any usage over Tier 1	0.13240	0.08079	0.00549	0.21868
Customer Charge ($/month)				4.64

D. SPECIAL NOTES:

1. Calculation of Cost Components

The actual bill amount is calculated based on the applicable rates in Section C above and adjusted for any applicable discounts, surcharges and/or taxes. On a Customer's bill statement, the bill amount may be broken down into appropriate components as calculated under Section C.

2. Calculation of Usage Tiers

Tier 1 Electricity usage shall be calculated and billed based upon a level of 15 kWh per day, prorated by Meter reading days of Service. As an example, for a 30-day bill, the Tier 1 level would be 450 kWh. For further discussion of bill calculation and proration, refer to Rule and Regulation 11.

{End}

CITY OF PALO ALTO UTILITIES
Issued by the City Council

CITY OF PALO ALTO UTILITIES

Supersedes Sheet No E-1-1 dated 7-1-2023

Sheet No **E-1-1**
Effective 7-1-2024

6.3.6 Sacramento Municipal Utilities District (Electric Only)

Following are the SMUD electricity tariffs applied in this study. The rates effective January 2025 were used.

Residential Time-of-Day Service
Rate Schedule R-TOD

II. Firm Service Rates

A. Time-of-Day (5-8 p.m.) Rate

	Effective as of January 1, 2023	Effective as of January 1, 2024	Effective as of May 1, 2024	Effective as of January 1, 2025	Effective as of May 1, 2025
Time-of-Day (5-8 p.m.) Rate (RT02)					
Non-Summer Season (October - May)					
System Infrastructure Fixed Charge *per month per meter*	$23.50	$24.15	$24.80	$25.50	$26.20
Electricity Usage Charge					
Peak *$/kWh*	$0.1547	$0.1590	$0.1633	$0.1678	$0.1724
Off-Peak *$/kWh*	$0.1120	$0.1151	$0.1183	$0.1215	$0.1248
Summer Season (June - September)					
System Infrastructure Fixed Charge *per month per meter*	$23.50	$24.15	$24.80	$25.50	$26.20
Electricity Usage Charge					
Peak *$/kWh*	$0.3279	$0.3369	$0.3462	$0.3557	$0.3655
Mid-Peak *$/kWh*	$0.1864	$0.1914	$0.1967	$0.2021	$0.2077
Off-Peak *$/kWh*	$0.1350	$0.1387	$0.1425	$0.1464	$0.1505

B. Optional Critical Peak Pricing Rate

1. The CPP Rate base prices per time-of-day period are the same as the prices per time-of-day period for TOD (5-8 p.m.).
2. The CPP Rate provides a discount per kWh on the Mid-Peak and Off-Peak prices during summer months.
3. During CPP Events, customers will be charged for energy used at the applicable time-of-day period rate plus the CPP Rate Event Price per kWh as shown on www.smud.org.
4. During CPP Events, energy exported to the grid will be compensated at the CPP Rate Event Price per kWh as shown on www.smud.org.
5. The CPP Rate Event Price and discount will be updated annually at SMUD's discretion and posted on www.smud.org.

C. Plug-In Electric Vehicle Credit (rate categories RT02 and RTC1)

This credit is for residential customers who have a licensed passenger battery electric plug-in or plug-in hybrid electric vehicle. Credit applies to all electricity usage charges from midnight to 6:00 a.m. daily.

Electric Vehicle Credit..... -$0.0150/kWh

III. Electricity Usage Surcharges

Refer to the following rate schedules for details on these surcharges.

A. Hydro Generation Adjustment (HGA). Refer to Rate Schedule HGA.

IV. Rate Option Menu

A. Energy Assistance Program Rate. Refer to Rate Schedule EAPR.

B. Medical Equipment Discount Program. Refer to Rate Schedule MED.

C. Joint Participation in Medical Equipment Discount and Energy Assistance Program Rate. Refer to Rate Schedule MED.

SACRAMENTO MUNICIPAL UTILITY DISTRICT Sheet No. **R-TOD-2**
Resolution No. 23-09-09 adopted September 21, 2023 Effective: **September 22, 2023**

V. Conditions of Service

A. Time-of-Day Billing Periods

Summer (Jun 1 - Sept 30)	**Peak**	Weekdays between 5:00 p.m. and 8:00 p.m.
	Mid-Peak	Weekdays between noon and midnight except during the Peak hours.
	Off-Peak	All other hours, including weekends and holidays[1].
Non-Summer (Oct 1 - May 31)	**Peak**	Weekdays between 5:00 p.m. and 8:00 p.m.
	Off-Peak	All other hours, including weekends and holidays[1].

[1] See Section V. Conditions of Service

6.3.7 Fuel Escalation Assumptions

The average annual escalation rates in Table 42 and Table 43 were used in this study. Table 42 rates are based on assumptions from the CPUC 2021 En Banc hearings on utility costs through 2030 (California Public Utilities Commission, 2021a). Escalation rates through the remainder of the 30-year evaluation period are based on the escalation rate assumptions within the 2022 TDV factors. No data was available to estimate electricity escalation rates for CPAU and SMUD, therefore electricity escalation rates for PG&E and statewide natural gas escalation rates were applied. Table 43 rates are based on the escalation rate assumptions within the 2025 LSC factors from 2026 through 2055.[9] These rates were developed for electricity use statewide (not utility-specific) and assume steep increases in gas rates in the latter half of the analysis period. Data was not available for the year 2026 and so the CPUC En Banc assumptions were applied for those years using the average rate across the three IOUs for statewide electricity escalation.

[9] https://www.energy.ca.gov/files/2025-energy-code-hourly-factors. (California Energy Commission, 2023). Actual escalation factors were provided by consultants E3.

Table 42. Real Utility Rate Escalation Rate Assumptions, CPUC En Banc and 2022 TDV Basis

	Statewide Natural Gas Residential Average Rate (%/year, real)	Electric Residential Average Rate (%/year, real)		
		PG&E	SCE	SDG&E
2026	4.6%	1.8%	1.6%	2.8%
2027	4.6%	1.8%	1.6%	2.8%
2028	4.6%	1.8%	1.6%	2.8%
2029	4.6%	1.8%	1.6%	2.8%
2030	4.6%	1.8%	1.6%	2.8%
2031	2.0%	0.6%	0.6%	0.6%
2032	2.4%	0.6%	0.6%	0.6%
2033	2.1%	0.6%	0.6%	0.6%
2034	1.9%	0.6%	0.6%	0.6%
2035	1.9%	0.6%	0.6%	0.6%
2036	1.8%	0.6%	0.6%	0.6%
2037	1.7%	0.6%	0.6%	0.6%
2038	1.6%	0.6%	0.6%	0.6%
2039	2.1%	0.6%	0.6%	0.6%
2040	1.6%	0.6%	0.6%	0.6%
2041	2.2%	0.6%	0.6%	0.6%
2042	2.2%	0.6%	0.6%	0.6%
2043	2.3%	0.6%	0.6%	0.6%
2044	2.4%	0.6%	0.6%	0.6%
2045	2.5%	0.6%	0.6%	0.6%
2046	1.5%	0.6%	0.6%	0.6%
2047	1.3%	0.6%	0.6%	0.6%
2048	1.6%	0.6%	0.6%	0.6%
2049	1.3%	0.6%	0.6%	0.6%
2050	1.5%	0.6%	0.6%	0.6%
2051	1.8%	0.6%	0.6%	0.6%
2052	1.8%	0.6%	0.6%	0.6%
2053	1.8%	0.6%	0.6%	0.6%
2054	1.8%	0.6%	0.6%	0.6%
2055	1.8%	0.6%	0.6%	0.6%

Table 43. Real Utility Rate Escalation Rate Assumptions, 2025 LSC Basis

Year	Statewide Natural Gas Residential Average Rate (%/year, real)	Statewide Electricity Residential Average Rate (%/year, real)
2026	4.6%	2.1%
2027	4.2%	0.6%
2028	3.2%	1.9%
2029	3.6%	1.6%
2030	6.6%	1.3%
2031	6.7%	1.0%
2032	7.7%	1.2%
2033	8.2%	1.1%
2034	8.2%	1.1%
2035	8.2%	0.9%
2036	8.2%	1.1%
2037	8.2%	1.1%
2038	8.2%	1.0%
2039	8.2%	1.1%
2040	8.2%	1.1%
2041	8.2%	1.1%
2042	8.2%	1.1%
2043	8.2%	1.1%
2044	8.2%	1.1%
2045	8.2%	1.1%
2046	8.2%	1.1%
2047	3.1%	1.1%
2048	-0.5%	1.1%
2049	-0.6%	1.1%
2050	-0.5%	1.1%
2051	-0.6%	1.1%
2052	-0.6%	1.1%
2053	-0.6%	1.1%
2054	-0.6%	1.1%
2055	-0.6%	1.1%

Get In Touch

The adoption of reach codes can differentiate jurisdictions as efficiency leaders and help accelerate the adoption of new equipment, technologies, code compliance, and energy savings strategies.

As part of the Statewide Codes & Standards Program, the Reach Codes Subprogram is a resource available to any local jurisdiction located throughout the state of California.

Our experts develop robust toolkits as well as provide specific technical assistance to local jurisdictions (cities and counties) considering adopting energy reach codes. These include cost-effectiveness research and analysis, model ordinance language and other code development and implementation tools, and specific technical assistance throughout the code adoption process.

If you are interested in finding out more about local energy reach codes, the Reach Codes Team stands ready to assist jurisdictions at any stage of a reach code project.

Visit

LocalEnergyCodes.com to access our resources and sign up for newsletters

Contact

info@localenergycodes.com for no-charge assistance from expert Reach Code advisors

Explore

The Cost-Effectiveness Explorer is a free resource to help California local governments and stakeholders develop energy policies for buildings.

Follow

us on Linkedin

Revision: 1.0
Last modified: 2025/06/09

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Last modified: 2024/04/25
Revision: 1.0

2022 Cost-Effectiveness Study: Existing Single Family Building Upgrades

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Prepared for:
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SDGE™ SOUTHERN CALIFORNIA EDISON® Energy for What's Ahead® PG&E Pacific Gas and Electric Company®

Legal Notice

Acronym List

2023 PV$ – Present value costs in 2023

ACH50 – Air Changes per Hour at 50 pascals pressure differential

ACM – Alternative Calculation Method

ADU – Accessory Dwelling Unit

AFUE – Annual Fuel Utilization Efficiency

B/C – Lifecycle Benefit-to-Cost Ratio

BEopt – Building Energy Optimization Tool

BSC – Building Standards Commission

CA IOUs – California Investor-Owned Utilities

CASE – Codes and Standards Enhancement

CBECC-Res – Computer program developed by the California Energy Commission for use in demonstrating compliance with the California Residential Building Energy Efficiency Standards

CEER – Combined Energy Efficiency Rating

CFI – California Flexible Installation

CFM – Cubic Feet per Minute

CO_2 – Carbon Dioxide

CPAU – City of Palo Alto Utilities

CPUC – California Public Utilities Commission

CZ – California Climate Zone

DFHP – Dual Fuel Heat Pump

DHW – Domestic Hot Water

DOE – Department of Energy

DWHR – Drain Water Heat Recovery

EDR – Energy Design Rating

EER – Energy Efficiency Ratio

EF – Energy Factor

GHG – Greenhouse Gas

HERS Rater – Home Energy Rating System Rater

HPA – High Performance Attic

HPSH – Heat Pump Space Heater

HPWH – Heat Pump Water Heater

HSPF – Heating Seasonal Performance Factor

HVAC – Heating, Ventilation, and Air Conditioning

IECC – International Energy Conservation Code

IOU – Investor Owned Utility

kBtu –British thermal unit (x1000)

kWh – Kilowatt Hour

LBNL – *Lawrence Berkeley National Laboratory*

LCC – Life Cycle Cost

LLAHU – Low Leakage Air Handler Unit

VLLDCS – Verified Low Leakage Ducts in Conditioned Space

LSC – Long-term Systemwide Cost

MF – Multifamily

MSHP – Mini-Split Heat Pump

NEEA – Northwest Energy Efficiency Alliance

NEM – Net Energy Metering

NPV – Net Present Value

NREL – *National Renewable Energy Laboratory*

PG&E – Pacific Gas and Electric Company

POU – Publicly-Owned-Utilities

PV – Photovoltaic

SCE – Southern California Edison

SDG&E – San Diego Gas and Electric

SEER – Seasonal Energy Efficiency Ratio

SF – Single Family

SMUD – Sacramento Municipal Utility District

SoCalGas – Southern California Gas Company

TDV – Time Dependent Valuation

Therm – Unit for quantity of heat that equals 100,000 British thermal units

Title 24 – Title 24, Part 6

TOU – Time-Of-Use

UEF – Uniform Energy Factor

VCHP – Variable Capacity Heat Pump, Title 24 compliance credit

ZNE – Zero-net Energy

Summary of Revisions

Date	Description	Reference (page or section)
4/25/2024	Original Release	N/A

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Executive Summary

The California Codes and Standards (C&S) Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy efficiency and greenhouse gas (GHG) reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

This report documents cost-effective measure upgrades in existing single family buildings that exceed the minimum state requirements. It evaluates efficiency measures such as adding insulation, replacing windows, and duct upgrades, fuel substitution measures that upgrade space heating and water heating to heat pumps, and solar photovoltaics (PV) across all 16 California climate zones. A 1,665 square foot single family home prototype with an attached garage was evaluated in this study.

This analysis used two different metrics to assess the cost-effectiveness of the proposed upgrades. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with each energy efficiency measure over a 30-year analysis period. On-Bill cost-effectiveness is a customer-based lifecycle cost (LCC) approach that values energy based upon estimated site energy usage and customer utility bill savings using today's electricity and natural gas utility tariffs. Long-term Systemwide Cost (LSC) is the California Energy Commission's LCC methodology for the 2025 Title 24, Part 6 (Title 24) code cycle (previously referred to as Time Dependent Valuation (TDV)), which is intended to capture the long-term projected cost of energy including costs for providing energy during peak periods of demand, carbon emissions, grid transmission and distribution impacts. This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in Title 24 code development.

The following summarizes key results from the study:

Conclusions and Discussion:

1. Envelope measures. Improving envelope performance is very cost-effective in many older homes. In addition to reducing utility costs, these measures provide many other benefits such as improving occupant comfort and satisfaction and increasing a home's ability to maintain temperatures during extreme weather events and power outages. Below is a discussion of the results of specific measures.
    a. Adding attic insulation is cost-effective based on both LSC and On-Bill in many climate zones in homes with no more than R-19 existing attic insulation levels. Increasing attic insulation from R-30 to R-49 was still found to be cost-effective based on at least one metric in the colder and hotter climates of Climate Zone 10 (SDG&E territory only) through 16.
    b. Insulating existing uninsulated walls is very cost-effective based on both metrics everywhere except Climate Zones 6 and 7 (in Climate Zone 8 it's only cost-effective based on LSC).
    c. Adding R-19 or R-30 floor insulation is cost-effective based on LSC in the older two vintages (Pre-1978 and 1978-1991) in all CZ except CZ 6-10.
    d. Replacing old single pane windows with new high-performance windows has a very high cost and is typically not done for energy savings alone. However, energy savings are substantial and justify cost-effectiveness of this measure based on at least one metric in Climate Zones 4, 8 through 12 (PG&E territory only), and 13 through 16.
    e. At time of roof replacement, a cool roof with an aged solar reflectance of 0.25 was found to be cost-effective in Climate Zones 4, 6 through 12 (PG&E territory only), and 13 through 15. When the roof deck is replaced during a roof replacement, adding a radiant barrier is low cost and provides substantial cooling energy savings, and was found to be cost-effective in almost all climate zones and homes.
2. Duct measures: Many older homes have old, leaky duct systems that should be replaced when they reach the end of life, typically 20-30 years. In this case, installing new ducts was found to be cost-effective based on at least one metric (both in most cases) everywhere except mild Climate Zone 7 and Climate Zones 5 and 6 in

the 1978-1991 vintage. If duct systems still have remaining life they should be sealed and tested to meet 10% leakage or lower; however, duct upgrades alone were only found to be cost-effective for newer homes in Climate Zones 10 (SDG&E territory only), 11, and 13 through 16. Duct upgrades may be able to be coupled with other measures to reduce the cost.

3. Heat pump space heating: HPSHs were found to be LSC cost-effective in many cases. The Dual Fuel Heat Pump (existing furnace) was LSC cost-effective everywhere except Climate Zone 15. The HPSH was LSC cost-effective everywhere except Climate Zones 8 and 15.
    a. Challenges to On-Bill cost-effectiveness include higher first costs and higher first-year utility costs due to higher electricity tariffs relative to gas tariffs. SMUD and CPAU are two exceptions where first year utility costs are lower for heat pumps than for gas equipment. Table 11 shows the impact of utility rates on cost-effectiveness of HPSH where the standard and high efficiency HPSH and the HPSH + PV measures are cost-effective under SMUD but not PG&E. Even with higher first year utility bills, there were some cases that still proved On-Bill cost-effective including the DFHP with an existing furnace in the central valley and northern coastal PG&E territories, the ducted MSHP in the central valley as well as Climate Zone 14 in SDG&E territory, and the HPSH + PV measure in CZ 3-5 (PGE), 7-11, and 12 (SMUD) – 15.
    b. The ductless MSHPs were only found to be cost-effective based on either metric in Climate Zones 1 and 16. Ductless MSHPs have a high incremental cost because it is a more sophisticated system than the base model of a wall furnace with a window AC unit. However, the ductless MSHP would provide greater comfort benefits if properly installed to directly condition all habitable spaces (as is required under the VCHP compliance credit as evaluated in this study) which may be an incentive for a homeowner to upgrade their system.
    c. Higher efficiency equipment lowered utility costs in all cases and improved cost-effectiveness in many cases, particularly with a ducted MSHP.
4. Heat pump water heating: All the HPWH measures were LSC cost-effective in all climate zones. Most measures were not On-Bill cost-effective with the exception of the HPWH + PV which was cost-effective On-Bill in CPAU, SMUD, and SDG&E territories in addition to Climate Zones 11, 13, 14, and 15. The HPWH measures share many of the same challenges as the HPSH measures to achieving cost-effectiveness including high first costs and utility rates and assumptions. Table 13 shows the impact of utility rates on cost-effectiveness where some HPWH measures are cost-effective under SMUD utility rates but are not cost-effective anywhere under PG&E rates in Climate Zone 12.
    a. Various HPWH locations were also explored, however there are some factors outside of cost-effectiveness that should also be considered.
        i. HPWHs in the conditioned space can provide benefits such as free-cooling during the summer, reduced tank losses, and shorter pipe lengths, and in some cases show improved cost-effectiveness over garage located HPWHs. However, there are various design considerations such as noise, comfort concerns, an additional heating load in the winter, and condensate removal. Ducting the inlet and exhaust air resolves comfort concerns but adds costs and complexity. Split heat pump water heaters address these concerns, but currently there are limited products on the market and there is a cost premium relative to the packaged products.
        ii. Since HPWHs extract heat from the air and transfer it to water in the storage tank, they must have adequate ventilation to operate properly. Otherwise, the space cools down over time, impacting the HPWH operating efficiency. This is not a problem with garage installations but needs to be considered for water heaters located in interior or exterior closets. For the 2025 Title 24 code the CEC is proposing that all HPWH installations meet mandatory ventilation requirements (California Energy Commission, 2023).
5. The contractor surveys revealed overall higher heat pump costs than what has been found in previous analyses. This could be due to incentive availability raising demand for heat pumps and thereby increasing the price. This price increase may be temporary and may come down once the market stabilizes. There are also

new initiatives to obtain current costs including the TECH Clean California program[1] that publishes heat pump data and costs; however, at the time of this analysis, the TECH data did not contain incremental costs because it only had the heat pump costs but not the gas base case costs.

6. Table 18 shows how CARE rates and escalation rate assumptions will impact cost-effectiveness.
    a. Applying CARE rates in the IOU territories has the overall impact to increase utility cost savings for an all-electric building compared to a code compliant mixed fuel building, improving On-Bill cost-effectiveness. This is due to the CARE discount on electricity being higher than that on gas. The reverse occurs with efficiency measures where lower utility rates reduce savings and subsequently reduce cost-effectiveness.
    b. If gas tariffs are assumed to increase substantially over time, in-line with the escalation assumption from the 2025 LSC development, cost-effectiveness substantially improves for the heat pump measures over the 30-year analysis period and many cases become cost-effective that were not found to be cost-effective under the CPUC / 2022 TDV escalation scenario. There is much uncertainty surrounding future tariff structures as well as escalation values. While it's clear that gas rates will increase, how much and how quickly is not known. Future electricity tariff structures are expected to evolve over time, and the CPUC has an active proceeding to adopt an income-graduated fixed charge that benefits low-income customers and supports electrification measures for all customers.[2] The CPUC will make a decision in mid-2024 and the new rates are expected to be in place later that year or in 2025. While the anticipated impact of this rate change is lower volumetric electricity rates, the rate design is not finalized. While lower volumetric electricity rates provide many benefits, it also will make building efficiency measures harder to justify as cost-effective due to lower utility bill cost savings.
7. Under NBT, utility cost savings for PV are substantially less than what they were under prior net energy metering rules (NEM 2.0); however, savings are sufficient to be On-Bill cost-effective in all climate zones except Climate Zones 1 through 3, 5, and 6.
    a. Combining a heat pump with PV allows the additional electricity required by the heat pump to be offset by the PV system while also increasing on-site utilization of PV generation rather than exporting the electricity back to the grid at a low rate.
    b. While not evaluated in this study, coupling PV with battery systems can be very advantageous under NBT increasing utility cost savings because of improved on-site utilization of PV generation and fewer exports to the grid.

Recommendations:

1. There are various approaches for jurisdictions who are interested in reach codes for existing buildings. Some potential approaches are listed below along with key considerations.
    a. Prescriptive measures: Non-preempted measures that are found to be cost-effective may be prescriptively required in a reach code. One example of this type or ordinance is a cool roof requirement at time of roof replacement. Another example is requiring specific cost-effective measures for larger remodels, such as high-performance windows when new windows are installed or duct sealing and testing when ducts are in an unconditioned space.
    b. Replacement equipment: This flavor of reach code sets certain requirements at time of equipment replacement. This study evaluated space heating and water heating equipment. Where a heat pump measure was found to be cost-effective based on either LSC or On-Bill, this may serve as the basis of a reach code given the following considerations.
        i. Where reach codes reduce energy usage and are not just fuel switching, cost-effectiveness calculations are required and must be based on equipment that does not exceed the federal minimum efficiency requirements.
        ii. Where reach codes are established using cost-effectiveness based on LSC, utility bill impacts and the owner's first cost should also be reviewed and considered.

[1] TECH Public Reporting Home Page (techcleanca.com)
[2] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking

iii. A gas path should also be prescriptively allowed to safely satisfy federal preemption requirements considering the CRA v. Berkeley case.[3] Additional requirements may apply to the gas path, as described in Section 3.3, as long as the paths are reasonably energy or cost equivalent.

c. "Flexible Path", minimum energy savings target: This flexible approach establishes a target for required energy savings based on a measure or a set of measures that were found to be cost-effective based on either LSC or On-Bill. A points menu compares various potential upgrades ranging from efficiency, PV, and fuel substitution measures, based on site or source energy savings. The applicant must select upgrades that individually or in combination meet the minimum energy savings target. The maximum target value shown in the Cost-effectiveness Explorer is based on a combination of cost-effective, non-preempted measures.

2. Equipment replacement ordinances should consider appropriate exceptions for scenarios where it will be challenging to meet the requirements, such as location of the HPWH, total project cost limitations, or the need for service panel upgrades that wouldn't have been required as part of the proposed scope of work in absence of the reach code.
3. Consider extending relevant proposals made by the CEC for the 2025 Title 24 code (California Energy Commission, 2023) in ordinances that apply under the 2022 Title 24 code, such as the following:
    a. Mandatory ventilation requirements for HPWH installations (Section 110.3(c)7). The cost-effectiveness analysis can be found in the Multifamily Domestic Hot Water CASE report (Statewide Team, 2023).
    b. Requirement for HERS verified refrigerant charge verification for heat pumps in all climate zones (Table 150.1-A[4]). The cost-effectiveness analysis can be found in the Residential HVAC Performance CASE report (Statewide Team, 2023).
4. When evaluating reach code strategies, the Reach Codes Team recommends that jurisdictions consider combined benefits of energy efficiency alongside electrification. Efficiency and electrification have symbiotic benefits and are both critical for decarbonization of buildings. As demand on the electric grid is increased through electrification, efficiency can reduce the negative impacts of additional electricity demand on the grid, reducing the need for increased generation and storage capacity, as well as the need to upgrade upstream transmission and distribution equipment.
5. Education and training can play a critical role in ensuring that heat pumps are installed, commissioned, and controlled properly to mitigate grid impacts and maximize occupant satisfaction. Below are select recommended strategies.
    a. The Quality Residential HVAC Services Program[5] is an incentive program to train California contractors in providing quality installation and maintenance while advancing energy-efficient technologies in the residential HVAC industry. Jurisdictions can market this to local contractors to increase the penetration of contractors skilled in heat pump design and installation.
    b. Educate residents and contractors of available incentives, tax credits, and financing opportunities.
    c. Educate contractors on code requirements. Energy Code Ace provides free tools, training, and resources to help Californians comply with the energy code. Contractors can access interactive compliance forms, fact sheets, and live and recorded trainings, among other things, on the website: https://energycodeace.com/. Jurisdictions can reach out to Energy Code Ace directly to discuss offerings.
6. Health and safety
    a. Combustion Appliance Safety and Indoor Air Quality: Implementation of some of the recommended measures will affect the pressure balance of the home which can subsequently impact the safe operation of existing combustion appliances as well as indoor air quality. Buildings with older gas appliances can present serious health and safety problems which may not be addressed in a remodel

[3] https://www.publichealthlawcenter.org/sites/default/files/2024-01/CRA-v-Berkeley-Ninth-Circuit-Opinion-Jan2024.pdf
[4] This requirement does not show up in the Express Terms for alterations in Section 150.2(b)1F, but the Statewide Reach Codes Team expects that it will be added to the next release of the proposed code language in the 45-day language as it aligns with the proposal made by the Codes and Standards Enhancement Team (Statewide CASE Team, 2023).
[5] https://qualityhvac.frontierenergy.com/

if the appliances are not being replaced. It is recommended that the building department require inspection and testing of all combustion appliances located within the pressure boundary of the building after completion of retrofit work that involves air sealing or insulation measures.

b. Jurisdictions may consider requiring mechanical ventilation in homes where air sealing has been conducted. In older buildings, outdoor air is typically introduced through leaks in the building envelope. After air sealing a building, it may be necessary to forcefully bring in fresh outdoor air using supply and/or exhaust fans to minimize potential issues associated with indoor air quality.

Local jurisdictions may also adopt ordinances that amend different Parts of the California Building Standards Code or may elect to amend other state or municipal codes. The decision regarding which code to amend will determine the specific requirements that must be followed for an ordinance to be legally enforceable. For example, reach codes that amend Part 6 of the CA Building Code and require energy performance beyond state code minimums must demonstrate the proposed changes are cost-effective and obtain approval from the Energy Commission as well as the Building Standards Commission (BSC). Amendments to Part 11, such as requirements for increased water efficiency or electric vehicle infrastructure only require BSC approval. Although a cost-effectiveness study is only required to amend Part 6 of the CA Building Code, this study provides valuable context for jurisdictions pursuing other ordinance paths to understand the economic impacts of any policy decision. This study documents the estimated costs, benefits, energy impacts and greenhouse gas emission reductions that may result from implementing an ordinance based on the results to help residents, local leadership, and other stakeholders make informed policy decisions.

This report documents the key results and conclusions from the Reach Codes Team analysis. A full dataset of all results can be downloaded at https://localenergycodes.com/content/resources. Results alongside policy options can also be explored using the Cost-effectiveness Explorer at https://explorer.localenergycodes.com/. Model ordinance language and other resources are posted on the C&S Reach Codes Program website at LocalEnergyCodes.com. Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at info@localenergycodes.com.

1 Introduction

This report documents cost-effective measure upgrades in existing single family buildings that exceed the minimum state requirements, the 2022 Building Energy Efficiency Standards, effective January 1, 2023. Local jurisdictions in California may consider adopting local energy ordinances to achieve energy savings beyond what will be accomplished by enforcing building efficiency requirements that apply statewide. This report was developed in coordination with the California Statewide Investor-Owned Utilities (IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Statewide Reach Codes Team.

The focus of this study is on existing single family buildings and does not apply to low or high-rise multifamily buildings. Each jurisdiction must establish the appropriate structure and threshold for triggering the proposed requirements. Some common jurisdictional structures include triggering the requirements at major remodels, additions, or date-certain (upgrades must be completed by a specific date). Some of these measures could be triggered with a permit for another specific measure, such as a re-roofing project. The analysis includes scenarios of individual measures and identifies cost-effective options based on the existing conditions of the building in all 16 California Climate Zones (CZ) (see Cost-Effectiveness Results for a graphical depiction of climate zone locations).

This report documents the key results and conclusions from the Reach Codes Team analysis. A full dataset of all results can be downloaded at https://localenergycodes.com/content/resources. Results alongside policy options can also be explored using the Cost-effectiveness Explorer at https://explorer.localenergycodes.com/.

The California Codes and Standards (C&S) Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy efficiency and greenhouse gas reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (CEC, 2019) is maintained and updated every three years by two state agencies: the California Energy Commission (the Energy Commission) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local energy efficiency ordinances—or reach codes—that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). Local jurisdictions must demonstrate that the requirements of the proposed ordinance are cost-effective and do not result in buildings consuming more energy than is permitted by Title 24. In addition, the jurisdiction must obtain approval from the Energy Commission and file the ordinance with the BSC for the ordinance to be legally enforceable.

The Department of Energy (DOE) sets minimum efficiency standards for equipment and appliances that are federally regulated under the National Appliance Energy Conservation Act, including heating, cooling, and water heating equipment (E-CFR, 2020). Since state and local governments are prohibited from adopting higher minimum efficiencies than the federal standards require, the focus of this study is to identify and evaluate cost-effective packages that do not include high efficiency heating, cooling, and water heating equipment. High efficiency appliances are often the easiest and most affordable measure to increase energy performance. While federal preemption limits reach code mandatory requirements for covered appliances, in practice, builders may install any package of compliant measures to achieve the performance requirements.

2 Methodology and Assumptions

2.1 Analysis for Reach Codes

This section describes the approach to calculating cost-effectiveness including benefits, costs, metrics, and utility rate selection.

2.1.1 Modeling

The Reach Codes Team performed energy simulations using the 2025 research version of the Residential California Building Energy Code Compliance software (CBECC). The 2025 version of CBECC was used instead of the 2022 version to take advantage of updated weather files and metrics. Site energy results are similar between CBECC-Res 2022 and 2025; however, the 2025 compliance metrics applies assumptions reflective of an electrified future, such as high escalation for natural gas retail rates, which favors electric buildings. In addition, in 2025 the weather stations were changed in Climate Zones 4 and 6 from San Jose to Paso Robles and Torrance to Los Angeles International Airport, respectively.

Three unique building vintages are considered: pre-1978, 1978-1991, and 1992-2010. The vintages were defined based on review of historic Title 24 code requirements and defining periods with distinguishing features. Prospective energy efficiency measures were identified and modeled to determine the projected site energy (therm and kWh), source energy, GHG emissions, and LSC (long-term systemwide cost) impacts. Annual utility costs were calculated using hourly data output from CBECC, and current (as of 11/01/2023) electricity and natural gas tariffs for each of the investor-owned utilities (IOUs) appropriate for that climate zone.

Equivalent CO_2 emission reductions were calculated based on outputs from the CBECC-Res simulation software. Electricity emissions vary by region and by hour of the year. CBECC-Res applies two distinct hourly profiles, one for Climate Zones 1 through 5 and 11 through 13 and another for Climate Zones 6 through 10 and 14 through 16. Natural gas emissions do not vary hourly. To compare the mixed-fuel and all-electric cases side-by-side, GHG emissions are presented as lbs CO_2-equivalent (CO_2e) emissions.

The Statewide Reach Codes Team designed the analysis approach and selected measures for evaluation based on the 2019 existing building single family reach code analysis (Statewide Reach Codes Team, 2021) and work to support the 2025 Title 24 code development cycle as well as from outreach to architects, builders, and engineers.

2.1.2 Prototype Characteristics

The Energy Commission defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. Average home size has steadily increased over time,[6] and the Energy Commission single family new construction prototypes are larger than many existing single family homes across California. For this analysis, a 1,665 square foot prototype was evaluated. Table 1 describes the basic characteristics of the single family prototype. Additions are not evaluated in this analysis as they are already addressed in Section 150.2 of Title 24, Part 6. The CEC has proposed changes to the 2025 Energy Code that would remove the allowance of gas space heating and water heating equipment for additions and instead require additions to follow the same space heating and water heating equipment requirements as new construction (California Energy Commission, 2023). The proposed prescriptive requirements for single family new construction homes are heat pump space heaters and water heaters, with gas equipment only allowed in the performance approach.

[6] https://www.census.gov/const/C25Ann/sftotalmedavgsqft.pdf

Table 1. Prototype Characteristics

	Specification
Existing Conditioned Floor Area	1,665 ft^2
Num. of Stories	1
Num. of Bedrooms	3
Window-to-Floor Area Ratio	13%
Attached Garage	2-car garage

Three building vintages were evaluated to determine sensitivity of existing building performance on cost-effectiveness of upgrades. For example, it is widely recognized that adding attic insulation in an older home with no insulation is cost-effective, however, newer homes will likely have existing attic insulation reducing the cost-effectiveness of an incremental addition of insulation. The building characteristics for each vintage were determined based on either prescriptive requirements from Title 24 that were in effect or standard construction practice during that time period. Homes built under 2001 Title 24 are subject to prescriptive envelope code requirements very similar to homes built under the 2005 code cycle, which was in effect until January 1, 2010.

Table 2 summarizes the assumptions for each of the three vintages. Additionally, the analysis assumed the following features when modeling the prototype buildings. Efficiencies were defined by year of the most recent equipment replacement based on standard equipment lifetimes.

- Individual space conditioning and water heating systems, one per single family building.
- Split-system air conditioner with natural gas furnace.
    - Scenarios with an existing natural gas wall furnace without AC were also evaluated.
- Small storage natural gas water heater.
    - Scenarios with an existing electric resistance storage water heater were also evaluated.
- Gas cooktop, oven, and clothes dryer.

The methodology applied in the analyses begins with a design that matches the specifications as described in Table 2 for each of the three vintages. Prospective energy efficiency measures were modeled to determine the projected energy performance and utility cost impacts relative to the baseline vintage. In some cases, where logical, measures were packaged together.

Table 2. Efficiency Characteristics for Three Vintage Cases

Building Component Efficiency Feature	Vintage Case		
	Pre-1978	1978-1991	1992-2010
Envelope			
Exterior Walls	2x4, 16-inch on center wood frame, R-0[a]	2x4 16 inch on center wood frame, R-11	2x4 16 inch on center wood frame, R-13
Foundation Type & Insulation	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-19 (CZ 1 & 16)
Ceiling Insulation & Attic Type	Vented attic, R-5 @ ceiling level for CZ 6 & 7, Vented attic, R-11 @ ceiling level (all other CZs)	Vented attic, R-19 @ ceiling level	Vented attic, R-30 @ ceiling level
Roofing Material & Color	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)
Radiant Barrier	No	No	No
Window Type: U-factor/SHGC[b]	Metal, single pane: 1.16/0.76	Metal, dual pane: 0.79/0.70	Vinyl, dual pane Low-E: 0.55/0.40
House Infiltration at 50 Pascals	15 ACH50	10 ACH50	7 ACH50
HVAC Equipment			
Heating Efficiency	78 AFUE (assumes 2 replacements)	78 AFUE (assumes 1 replacement)	78 AFUE
Cooling Efficiency	10 SEER (assumes 2 replacements)	10 SEER (assumes 1 replacement)	13 SEER, 11 EER
Duct Location & Details	Attic, R-2.1, 30% leakage at 25 Pa	Attic, R-2.1, 25% leakage at 25 Pa	Attic, R-4.2, 15% leakage at 25 Pa
Whole Building Mechanical Ventilation	None	None	None
Water Heating Equipment			
Water Heater Efficiency	0.575 Energy Factor (assumes 2 replacements)	0.575 Energy Factor (assumes 1 replacement)	0.575 Energy Factor
Water Heater Type	40-gallon gas storage	40-gallon gas storage	40-gallon gas storage
Pipe Insulation	None	None	None
Hot Water Fixtures	Standard, non-low flow	Standard, non-low flow	Standard, non-low flow

[a] Pre-1978 wall modeled with R-5 cavity insulation to better align wall system performance with monitored field data and not overestimate energy use.

[b] Window type selections were made based on conversations with window industry expert, Ken Nittler. If a technology was entering the market during the time period (e.g., Low-E during 1992-2010 or dual-pane during 1978-1991) that technology was included in the analysis. This provides a conservative assumption for overall building performance and additional measures may be cost-effective for buildings with lower performing windows, for example buildings with metal single pane windows in the 1978-1991 vintage.

2.1.3 Cost-Effectiveness Approach

2.1.3.1 Benefits

This analysis used two different metrics to assess the cost-effectiveness of the proposed upgrades. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with each energy efficiency measure. The main difference between the methodologies is the way they value energy impacts (the numerator in the benefit cost calculation):

Utility Bill Impacts (On-Bill): This customer-based lifecycle cost (LCC) approach values energy based upon estimated site energy usage and customer utility bill savings using the latest electricity and natural gas utility tariffs available at the time of writing this report. Total savings are estimated over a 30-year duration and include discounting of future utility costs, as well as assumed energy cost inflation over time.

Long-term Systemwide Cost (LSC): Formerly known as Time Dependent Valuation (TDV) energy cost savings, LSC reflects the Energy Commission's current LCC methodology, which is intended to capture the total value or cost of energy use over 30 years. This method accounts for the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade-based CO2 emissions (California Energy Commission, 2023). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in the 2025 Energy Code.

2.1.3.2 Costs

The Reach Codes Team assessed the incremental costs of the measures and packages over a 30-year analysis period. Incremental costs represent the equipment, installation, replacement, and maintenance costs of the proposed measure relative to the 2022 Title 24 Standards minimum requirements or standard industry practices. Present value of replacement cost is included only for measures with lifetimes less than the 30-year evaluation period. In cases where at the end of the analysis period the measure has useful life remaining, the value of this remaining life is calculated and credited in the total lifetime cost.

2.1.3.3 Metrics

Cost-effectiveness is presented using net present value (NPV) and benefit-to-cost (B/C) ratio metrics.

NPV: Equation 1 demonstrates how lifetime NPV is calculated. If the NPV of a measure or package is positive, it is considered cost-effective. A negative value represents a net increase in costs over the 30-year lifetime.

B/C Ratio: This is the ratio of the present value of all benefits to the present value of all costs over 30 years (present value benefits divided by present value costs). A value of one indicates the NPV of the savings over the life of the measure is equivalent to the NPV of the lifetime incremental cost of that measure. A value greater than one represents a positive return on investment. The B/C ratio is calculated according to Equation 2.

Equation 1

$$NPV = present\ value\ of\ lifetime\ benefit - present\ value\ of\ lifetime\ cost$$

Equation 2

$$Benefit - to - Cost\ Ratio = \frac{present\ value\ of\ lifetime\ benefit}{present\ value\ of\ lifetime\ cost}$$

Improving the efficiency of a project often requires an initial incremental investment. In most cases the benefit is represented by annual On-Bill utility or LSC savings, and the cost is represented by incremental first cost and future replacement costs. Some packages result in initial construction cost savings relative to the assumed base case scenario, and either energy cost savings (positive benefits), or increased energy costs (negative benefits). In cases where both construction costs and energy-related savings are negative, the construction cost savings are treated as the 'benefit' while the increased energy costs are the 'cost.' In cases where a measure or package is cost-effective immediately (i.e., upfront construction cost savings and lifetime energy cost savings), B/C ratio cost-effectiveness is represented by ">1".

The lifetime costs or benefits are calculated according to Equation 3.

Equation 3

$$Present\ value\ of\ lifetime\ cost\ or\ benefit = \sum_{t=0}^{n} \frac{(Annual\ cost\ or\ benefit)_t}{(1+r)^t}$$

Where:

1. n = analysis term in years
2. r = discount rate

The following summarizes the assumptions applied in this analysis to both methodologies.

3. Analysis term of 30 years
4. Real discount rate of three percent

Both base case measures and alternative energy efficiency measures may have different lifetime assumptions which impact life cycle economics. Future costing of many of the evaluated electrification measures are only based on current cost assumption, which may be overly conservative as the expected growth in heat pump-based technologies is growing rapidly and will likely lead to future cost reductions (at least relative to current fossil fueled equipment) as production volumes increase.

2.1.4 Utility Rates

In coordination with the CA IOU rate team (comprised of representatives from Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E)) and two Publicly-Owned-Utilities (POUs) (Sacramento Municipal Utility District (SMUD) and City of Palo Alto Utilities (CPAU)), the Reach Codes Team determined appropriate utility rates for each climate zone to calculate utility costs and determine On-Bill cost-effectiveness for the proposed measures and packages. The utility tariffs, summarized in Chapter 6.2, were determined based on the appropriate rate for each case in each territory. Utility rates were applied to each climate zone based on the predominant IOU serving the population of each zone, with a few climate zones evaluated multiple times under different utility scenarios. Climate Zones 10 and 14 were evaluated with both SCE for electricity and Southern California Gas Company (SoCalGas) for gas and SDG&E tariffs for both electricity and gas since each utility has customers within these climate zones. Climate Zone 5 is evaluated under both PG&E and SoCalGas natural gas rates. Two POU or municipal utility rates were also evaluated: SMUD in Climate Zone 12 and CPAU in Climate Zone 4.

For cases with onsite generation (i.e. solar photovoltaics (PV)), the approved NBT tariffs were applied along with monthly service fees and hourly export compensation rates for 2024.[7] In December 2022, the California Public Utilities Commission (CPUC) issued a decision adopting NBT as a successor to NEM 2.0 that went into effect April of 2023[8].

Utility rates are assumed to escalate over time according to the assumptions from the CPUC 2021 En Banc hearings on utility costs through 2030 (California Public Utilities Commission, 2021a). Escalation rates through the remainder of the 30-year evaluation period are based on the escalation rate assumptions within the 2022 TDV factors. The Statewide Natural Gas Residential Average Rate for 2023 through 2030 is projected to be 4.6%. The Electric Residential Average Rate for PG&E, SCE and SDG&E for 2023 through 2030 is projected to be 1.8%,1.6% and 2.8% respectively. A second set of escalation rates were also evaluated to demonstrate the impact that utility cost changes have on cost-effectiveness over time. This utility rate escalation sensitivity analysis, presented in Section 3.2.4, was based on those used within the 2025 LSC factors (LSC replaces TDV in the 2025 code cycle) which assumed steep

[7] Hourly export compensation rates were based on the NBT spreadsheet model created by E3 for the CPUC. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/net-energy-metering-nem/nemrevisit/nbt-model--12142022.xlsb

[8] https://www.cpuc.ca.gov/nemrevisit

increases in gas rates in the latter half of the analysis period. See Appendix 6.2.7 Fuel Escalation Assumptions for details.

Future electricity tariff structures are expected to evolve over time, and the CPUC has an active proceeding to adopt an income-graduated fixed charge that benefits low-income customers and supports electrification measures.[10] These were not included in this analysis but may be evaluated later in 2024 once the rates are finalized.

2.1.5 Measure Cost Data Collection Approach

To support this effort, a detailed cost study was completed in the summer of 2023 to gather data from a range of contractors to inform actual installed costs in the areas they provide services. These areas include HVAC, plumbing, envelope and air-sealing, and PV installation. Home performance contractors were also approached to collect this data. Collecting this type of data is challenging, both due to contractor reticence to share cost information and due to the timing of the survey which unfortunately coincided with the summer busy season for most contractors, especially HVAC installers. With these known challenges, the outreach effort focused on leveraging existing relationships between the analysis team and contractors to both gain access and provide assurance that all cost data would remain confidential and aggregated. Contractors that provided feedback were nominally compensated for their time.

The collected cost data was intended to represent recent costs for a “typical” retrofit installation. Each home in which a contractor does work has different site-specific issues that will likely affect costs. In addition, different jurisdictions have different levels of building department installation oversight and permit fees. Finally, each contractor typically has a different manufacturer product line they prefer to install. All these factors will influence installed costs[11].

The most detailed and broad cost request was for the HVAC contractors, as there are a wide range of equipment replacement scenarios available for an existing ducted gas furnace with central split-system air conditioning. Options range from a base case scenario (like for like swap out), split-system heat pump replacement, dual fuel heat pumps (DFHP), ducted mini-split heat pumps, non-ducted mini-splits, etc. For plumbing contractors, a range of scenarios existed for water heater replacements including like-for-like replacement, HPWHs (in different locations- garage, indoor), need for electrical upgrade for HPWH installation, need for HPWH ducting, etc. Envelope measures focused on attic and wall insulation, window replacement, re-roofing (with Cool Roof materials or not), and attic ceiling plane air-sealing. PV costing included different system sizes, panel upgrades costs, and battery costs. Home performance contractors were asked to provide as much data as they could on the different measure options. All costing information requested was intended to represent most recent installations, in an effort to capture current pricing as best as possible.

The contractors that responded with their cost estimates work in different regions of the state, operate in different markets with (potentially) different local efficiency incentives, do varying amounts of work based on the size of their company, target different market demographic sectors, and install different brands of equipment. All these factors will contribute to price variability. The Team considered applying climate zone specific cost adjustments to reflect some of these differences, but ultimately decided not to since a climate zone is not a monolithic entity with uniform customer pricing throughout. The Team recognizes that “zip code” pricing is a reality, but for simplicity, as well as consistency with Title 24, Part 6 code development costing approaches, applied uniform statewide costs to all measures.

2.2 Measure Details and Cost

This section describes the details of the measures and documents incremental costs. All measure costs were obtained from the contractor survey unless otherwise noted. All contractor provided costs reflect the cost to the customer and

[10] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking

[11] One HVAC contractor mentioned that equipment brand alone may contribute to a +/-%5 variation in the total bid cost.

include equipment, labor, permit fees, and required HERS testing. Additional details of the measures can be found in Appendix Section **Error! Reference source not found.**.

All measures are evaluated assuming they are not otherwise required by Title 24. For example, duct sealing is required by code whenever HVAC equipment is altered. For this analysis duct sealing was evaluated for those projects where it is not already triggered by code (i.e., no changes to the heating or cooling equipment). Where appropriate, measure requirements align with those defined in Title 24. In some cases, cost-effective measures were identified that exceed Title 24 requirements, such as attic insulation, cool roofs, and duct sealing.

2.2.1 Building Envelope & Duct Measures

The following are descriptions of each of the efficiency upgrade measures applied in this analysis.

Attic Insulation: Add attic insulation in buildings with vented attic spaces to meet either R-38 or R-49. The pre-1978 vintage assumes an existing condition of R-11, the 1978-1991 vintage assumes an existing condition of R-19, and the 1992-2010 vintage assumes R-30 as the existing insulation level. For pre-1978 vintage homes this measure was also evaluated to include air sealing of the attic. A 14% leakage reduction was modeled such that 15 ACH50 was reduced to 12.9 ACH50 in this measure. The costs for this measure include removing existing insulation.

Air Sealing and Weather-stripping: Apply air sealing practices throughout all accessible areas of the building. For this study, it was assumed that older vintage homes would be leakier than newer buildings and that approximately 30 percent improvement in air leakage is achievable through air sealing of all accessible areas. For modeling purposes, it was assumed that air sealing can reduce infiltration levels from 15 to ten air changes per hour at 50 Pascals pressure difference (ACH50) in the oldest vintages (pre-1978), to ten to seven ACH50 for the 1978-1991 vintage, and seven to five ACH50 in the 1992-2010 vintage.

Cool Roof: For steep slope roofs, install a roofing product rated by the Cool Roof Rating Council (CRRC) with an aged solar reflectance of 0.20 or 0.25 and thermal emittance of 0.75 or higher. This measure only applies to buildings that are installing a new roof as part of the scope of the remodel; the cost and energy savings associated with this upgrade reflects the incremental step between a standard roofing product with one that is CRRC rated with an aged solar reflectance of 0.20 or 0.25. This is similar to cool roof requirements in 2022 Title 24 Section 150.2(b)1Ii but assumes a higher solar reflectance.

Radiant Barrier: Add radiant barrier to any existing home vintage. This measure only applies to buildings that are installing a new roof as part of the scope of the remodel; the cost and energy savings associated with this upgrade reflects the incremental step between a standard roofing product with one that includes a laminated radiant barrier.

Raised Floor Insulation: In existing homes with raised floors and no insulation (pre-1978 and 1978-1991 vintages), add R-19 insulation. An upgraded R-30 floor insulation, assuming no current insulation, was evaluated in the pre-1978 and 1978-1991 vintages.

Wall Insulation: Blow-in R-13 wall insulation in existing homes without wall insulation (pre-1978 vintages).

Window Replacement: Replace existing windows with a non-metal dual-pane product, which has a U-factor equal to 0.28 Btu/hour-ft^2-°F or lower and a Solar Heat Gain Coefficient (SHGC) equal to 0.23 or lower, except in heating dominated climates (Climate Zones 1, 3, 5, and 16) where an SHGC of 0.35 was evaluated.

Duct Sealing, New Ducts, and Duct Insulation: Air seal all ductwork to meet the requirements of the 2022 Title 24, Part 6 Section 150.2(b)1E. For this analysis, final duct leakage values of ten percent (proposed revised leakage rate for 2022 Title 24) was evaluated. The pre-1978 and 1978-1992 vintages assume leaky existing ducts (25-30% leakage). The 1992-2010 vintage assumes moderately leaky existing ducts (15-20% leakage).

Replacing existing ductwork with entirely new ductwork to meet Sections 150.2(b)1Di and 150.2(b)1Diia of the 2022 Title 24 was also evaluated. This assumed new ducts meet 5% duct leakage and the option of R-6 and R-8 duct insulation in all climate zones.

Table 3 summarizes the cost assumptions for the building envelope and HVAC duct improvement measures evaluated. All the measures in Table 3 assume a 30-year effective useful life.

Table 3. Measure Cost Assumptions – Efficiency & Duct Measures

Measure	Performance Level	Incremental Cost – Single Family Building		
		Pre 1978	1978 – 1991	1992 - 2010
Wall Insulation	R-13	$2,950	N/A	N/A
Raised Floor Insulation	R-19	$3,633	$3,633	N/A
	R-30	$4,113	$4,113	$4,113
Attic Insulation	R-38	$6,762	$2,555	$1,781
	R-49	$7,446	$3,612	$1,827
Air Sealing	10 ACH50	$4,684	N/A	N/A
	7 ACH50	N/A	$4,684	N/A
	5 ACH50	N/A	N/A	$4,684
Cool Roof	0.25 Aged Solar Reflectance CZs 1-3,5-7,16	$2,407	$2,407	$2,407
	0.25 Aged Solar Reflectance CZs 4, 8-15	$1,203	$1,203	$1,203
Window U-factor/SHGC	0.28 U-factor. 0.23 SHGC in CZs 2,4,6-15.	$11,463	$11,463	$11,463
	0.28 U-factor. 0.35 SHGC in CZs 1,3,5,26	$11,871	$11,871	$11,871
Radiant Barrier	Add Radiant Barrier	$893	$893	$893
Duct Sealing	10% nominal airflow	$2,590	$2,590	$1,400
All New Duct System	R-6 ducts; 5% duct leakage	$4,808	$4,808	$4,808
	R-8 ducts; 5% duct leakage	$6,311	$6,311	$6,311

2.2.2 PV Measures

Installation of on-site PV is required in the 2022 Title 24 code for new construction homes, but there are no PV requirements for additions or alterations to existing buildings. PV was evaluated in CBECC-Res according to the California Flexible Installation (CFI) 1 assumptions and 98% solar access. To meet CFI eligibility, the requirements of 2022 Reference Appendices JA11.2.2 (California Energy Commission, 2021b) must be met. A 3 kW PV system was modeled both as a standalone measure as well as coupled with heat pump installations.

The costs for installing PV are summarized in Table 4. They include the first cost to purchase and install the system, future inverter replacement costs, and annual maintenance costs. Upfront solar PV system costs are estimated from the contractor surveys to be $4.58/$W_{DC}$ and are reduced by 30 percent to account for the federal income Residential Clean Energy Credit. The solar panels are estimated to have an effective useful life of 30 years and the inverter 25 years. The inverter replacement cost of $7,000 (future value) is also from the contractor surveys. System maintenance costs are taken from the 2019 PV CASE Report (California Energy Commission, 2017) and are assumed to be

$0.31/W$_{DC}$ present value. These costs do not include costs associated with electrical panel upgrades, which will be necessary in some instances.

Table 4. Measure Descriptions & Cost Assumptions – PV

Measure	Performance Level	Incremental Cost		
		Pre 1978	1978 – 1991	1992 - 2010
PV	3 kW	$9,608		

2.2.3 Equipment Fuel Substitution Measures – Heat Pump Equipment

The fuel substitution measures are evaluated as replacements at the end of the life of the existing equipment. This means the baseline compared against is usually a like-for-like change-out of the natural gas equipment, and the upgrade is a heat pump.

For most of the space heating and water heating cases, costs for electrical service panel upgrades are not included as it is assumed many existing homes have the service capacity to support converting one appliance from gas to electric. For homes with existing air conditioners, any incremental electric capacity necessary to support a heat pump space heater is marginal. The same applies for homes with existing electric resistance equipment. Section 3.2.4 presents the impacts for select cases where an upgrade to the electric panel is required.

Heat Pump Space Heating

All the heat pump space heater (HPSH) measures are described below. All were evaluated with HERS verified refrigerant charge aligned with the proposed code requirements for the 2025 Title 24 code. Dual fuel heat pumps (DFHPs) were controlled to lockout furnace operation above 35°F.

DFHP (Existing Furnace): Replace existing ducted air conditioner (AC) with an electric heat pump and install controls to operate the heat pump to use the existing gas furnace for backup heat. A minimum federal efficiency (14.3 SEER2, 11.7 EER2, 7.5 HSPF2) heat pump was evaluated. Savings are compared to a new AC (14.3 SEER2, 11.7 EER2) alongside the existing furnace (78 AFUE).

DFHP (New Furnace): Replace existing ducted AC and natural gas furnace with an electric heat pump and new gas furnace plus controls to operate the heat pump and use the new gas furnace for backup heat. A minimum federal efficiency (14.3 SEER2, 11.7 EER2, 7.5 HSPF2) heat pump and furnace (80 AFUE) were evaluated to replace existing equipment. Savings are compared to a new ducted AC and natural gas furnace (14.3 SEER2, 11.7 EER2, 80 AFUE).

Heat Pump Space Heater: Replace existing ducted AC and natural gas furnace with an electric heat pump. Minimum federal efficiency (14.3 SEER2, 11.7 EER2, 7.5 HSPF2) and higher efficiency (17 SEER2, 12.48 EER2, 9.5 HSPF2) heat pumps were evaluated. Savings are compared to a new ducted natural gas furnace and AC (14.3 SEER2, 11.7 EER2, 80 AFUE).

Ducted Mini-Split Heat Pump (MSHP): Replace existing ducted AC and natural gas furnace with a ducted high efficiency MSHP (16.5 SEER2, 12.48 EER2, 9.5 HSPF2). Savings are compared to a new ducted AC and natural gas furnace (14.3 SEER2, 11.7 EER2, 80 AFUE).

Ductless MSHP: In a home without AC, replace existing wall furnace with a ductless MSHP. A standard efficiency unit meeting minimum federal efficiency standards (14.3 SEER2, 11.7 EER2, 7.5 HSPF2) was evaluated by modeling the variable capacity heat pump (VCHP) compliance credit in CBECC-Res. A premium, higher efficiency upgrade was also

evaluated using CBECC-Res' detailed VCHP model[12] by simulating the performance of a representative high efficiency product (14.3 SEER2, 11.7 EER2, 7.5 HSPF2). Savings are compared to a new natural gas wall furnace with fan distribution (75% AFUE) and window AC (9 CEER).

Over the 30-year analysis period, certain changes are assumed when the equipment is replaced that impact both lifetime costs and energy use. Table 5 presents the lifetime scenario for the DFHP (existing furnace) measure. The analysis assumed a 20-year effective useful lifetime (EUL) for a furnace, a 15-year EUL for an air conditioner and a 15-year EUL for a heat pump. Lifetimes are based on the Database for Energy Efficient Resources (DEER) (California Public Utilities Commission, 2021b). The existing furnace is assumed to be halfway through its EUL at the beginning of the analysis period. After 10 years when the furnace reaches the end of its life and needs to be replaced, it will be subject to new federal efficiency standards for residential gas furnaces that go into effect in 2028 requiring 95 AFUE[13]. 5 years later the air conditioner reaches the end of its life and is replaced with a new air conditioner.

For the DFHP upgrade case, after 10 years when the furnace fails it's expected that the furnace will be abandoned in place since the heat pump serves primary heating and was sized to provide the full design heating load. In this case it is assumed that the fan motor would be replaced with a new aftermarket unit and would operate another 5 years until the heat pump fails and is replaced with a new heat pump and air handler.

The other ducted heat pump cases similarly apply a 95 AFUE furnace in the baseline when the furnace reaches its EUL after 20 years.

Table 5. Lifetime Analysis Replacement Assumptions for DFHP (Existing Furnace) Scenario

Year	Baseline	Upgrade
0	AC fails, install new AC, keep existing furnace	AC fails, install new HP, keep existing furnace
10	Furnace fails, install new 95AFUE furnace	Furnace fails, replace fan motor
15	AC fails, install new AC	HP fails, install new HP and air handler

Costs were applied based on the system capacity from heating and cooling load calculations in CBECC-Res as presented in Table 6. Air conditioner nominal capacity was calculated as the CBECC-Res cooling load, rounded up to the nearest half ton. Heat pump nominal capacity was calculated as the maximum of either the CBECC-Res heating or cooling load, rounded up to the nearest half ton. In both cases a minimum capacity of 1.5-ton was applied as this represents the typical smallest available split system heat pump equipment. Load calculations demonstrated that Climate Zones 2 - 15 were cooling-dominated while Climate Zones 1 and 16 were heating-dominated. In the heating dominated climate zones the heat pump needed to be upsized relative to an air conditioner that only provides cooling.

[12] The detailed VCHP option allows for the user to input detailed specifications based on the published National Energy Efficiency Partnership (NEEP) manufacturer specific performance data. It is not currently available for compliance analysis.

[13] https://www.energy.gov/articles/doe-finalizes-energy-efficiency-standards-residential-furnaces-save-americans-15-billion#:~:text=These%20furnace%20efficiency%20standards%20were,heat%20for%20the%20living%20space.

Table 6. System Sizing by Climate Zone

Climate Zone	Air Conditioner Capacity (tons)	Heat Pump Capacity (tons)
1	1.5	3.0
2	3.5	3.5
3	2.5	2.5
4	3.5	3.5
5	3.0	3.0
6	3.0	3.0
7	3.0	3.0
8	4.0	4.0
9	4.0	4.0
10	4.0	4.0
11	4.5	4.5
12	4.0	4.0
13	4.5	4.5
14	4.0	4.0
15	5.0	5.0
16	3.5	4.0

Table 7 presents estimated first and lifetime costs for the various ducted baseline and heat pump scenarios for 4-ton equipment. Costs include all material and installation labor including providing new 240 V electrical service to the air handler location for all new air handler installations and decommissioning of the furnace for the cases where the furnace is removed. DFHP costs incorporate controls installation and commissioning to ensure the heat pump and the furnace communicate properly and don't operate at the same time. Future replacement costs do not include any initial costs associated with 240V electrical service or furnace decommissioning.

Table 8 presents estimated first and lifetime costs for the ductless baseline and 2 heat pump scenarios, also for 4-ton heat pump equipment. EULs are based on 20 years for the gas wall furnace, 10 years for the window AC, and 15 years for the heat pump.[14]

[14] The gas wall furnace and heat pump EULs were based on DEER (California Public Utilities Commission, 2021b). Gas wall furnace lifetime was assumed to be the same as for central gas furnace equipment. Room air conditioner EUL was based on the DOE's latest rulemaking for room air conditioned (Department of Energy, 2023). DOE determined an average lifetime of 9.3 years, which was rounded up to 10 years for this analysis.

Table 7. Ducted HVAC Measure Cost Assumptions – 4-Ton Electric Replacements

Case	AC + Coil	Gas Furnace /AC	DFHP (Existing Furnace)	DFHP (New Furnace)	Min. Eff. Heat Pump	High Eff. Heat Pump	Ducted MSHP
Base Case	-	-	AC + Coil	Gas Furnace /AC	Gas Furnace /AC	Gas Furnace /AC	Gas Furnace /AC
First Cost	$10,402	$16,653	$12,362	$20,676	$17,825	$20,802	$18,075
Replacement Cost (Future Value)	$19,365	$19,365	$19,025	$19,025	$16,825	$19,802	$18,075
Replacement Cost (Present Value)	$13,346	$11,639	$12,334	$12,897	$10,800	$12,710	$11,601
Remaining Value at Year 30	$0	($1,846)	$0	($1,846)	$0	$0	$0
Total Lifecycle Cost	$23,748	$26,446	$24,696	$31,727	$28,625	$33,512	$29,676
Incremental Cost	-	-	**$948**	**$5,281**	**$2,179**	**$7,066**	**$3,230**

Table 8. Non-Ducted HVAC Measure Cost Assumptions – 4-Ton Electric Replacements

	Wall Furnace + Window AC	Min. Eff. Ductless MSHP	High Eff. Ductless MSHP
First Cost	$4,075	$17,412	$21,342
Replacement Cost (Future Value)	$4,075	$17,412	$21,342
Replacement Cost (Present Value)	$3,365	$11,176	$13,698
Remaining Value at Year 30	($532)	$0	$0
Total Lifecycle Cost	$6,908	$28,588	$35,040
Incremental Cost	-	**$21,680**	**$28,132**

Heat Pump Water Heating:

The heat pump water heater (HPWH) measures are described below, and costs are presented in Table 9 and Table 10. The most typical scenario in California is a home with existing natural gas storage tank water heaters. However, there are also many existing homes with existing electric resistance storage tank water heaters and this work considers both baselines. This analysis evaluates the following 65-gallon replacement HPWHs:

1. HPWH that meets the federal minimum efficiency requirements of UEF 2.0
2. HPWH that meets the Northwest Energy Efficiency Alliance (NEEA)[15] Tier 3 rating (3.45 UEF)
3. HPWH that meets the NEEA Tier 4 rating and that has demand response (DR) or load shifting control capability (4.02 UEF)
4. 120V HPWH that meets the NEEA Tier 3 rating (3.3 UEF).

[15] Based on operational challenges experienced in the past, NEEA established rating test criteria to ensure newly installed HPWHs perform adequately, especially in colder climates. The NEEA rating requires an Energy Factor equal to the ENERGY STAR® performance level and includes requirements regarding noise and prioritizing heat pump use over supplemental electric resistance heating.

The four cases above were evaluated with the HPWH located within an attached garage. Additionally, three separate cases for the federal minimum efficiency HPWH were analyzed to consider the impacts of location on performance and cost-effectiveness. These locations included the following:

1. Exterior closet.
2. Interior closet, no ducting.
3. Interior closet, ducted to the outside.

Additional costs for providing electrical wiring to these locations and for providing ductwork were included. Savings are compared to a new 50-gallon natural gas storage water heater (UEF 0.63) or a new 50-gallon electric water heater (UEF 0.92).

For this analysis, a HPWH that just meets the federal minimum efficiency standards of close to 2.0 Uniform Energy Factor (UEF) was evaluated in order to satisfy preemption requirements. However, the Reach Codes Team is not aware of any 2.0 UEF products that are available on the market. The lowest UEF reported for certified products in the Northwest Energy Efficiency Alliance (NEEA)[16] database is 2.73. In fact, of the four certification tiers offered by NEEA for high efficiency HPWHs, those meeting Tier 3 or Tier 4 are the dominant products on the market today. According to NEEA all major HPWH manufacturers are represented in NEEA's qualified product list[17] and there are fewer than 10 integrated products certified as Tier 1 or Tier 2, all of which have UEFs greater than 3.0.[18] Therefore, in this analysis, we refer to the NEEA rated HPWH as the "market standard" HPWH.

The HPWH costs for the 120V and NEEA certified units are based on a larger (60 or 65 gallon) HPWH, as most contractors are upsizing the HPWH tank size relative to an equal volume, but higher capacity gas storage water heater. Costs include all material and installation labor including providing a new 240 V electrical service to the water heater location (not needed for the 120V product). Water heating equipment lifetimes are based on DOE's recent water heater rulemaking (Department of Energy, 2022) and assume 15-year EULs for both the baseline water heaters and the HPWHs.[19] Future replacement costs for 240V HPWHs do not include any initial costs associated with 240V electrical service, condensate disposal, etc.

Table 9. Water Heating Measure Cost Assumptions – Existing Gas

	Gas Storage Water Heater	240V Fed. Min. HPWH	240V Market Std. NEEA HPWH	240V Market Std. NEEA HPWH + DR	120V Market Std. NEEA HPWH	240V Fed. Min. HPWH, Exterior Closet	240V Fed. Min. HPWH, Interior Closet, Not Ducted	240V Fed. Min. HPWH, Interior Closet, Ducted
First Cost	$2,951	$7,283	$8,144	$8,144	$5,844	$7,702	$7,363	$8,442
Replacement Cost (Future Value)	$2,951	$6,413	$7,274	$7,274	$5,101	$6,413	$6,413	$6,413
Replacement Cost (Present Value)	$1,894	$4,116	$4,669	$4,669	$3,274	$4,116	$4,116	$4,116
Total Lifecycle Cost	$4,845	$11,399	$12,813	$12,813	$9,118	$11,818	$11,479	$12,558
Incremental Cost	**-**	**$6,554**	**$7,968**	**$7,968**	**$4,273**	**$6,973**	**$6,634**	**$7,713**

[16] Based on operational challenges experienced in the past, NEEA established rating test criteria to ensure newly installed HPWHs perform adequately, especially in colder climates. The NEEA rating requires products comply with ENERGY STAR and includes requirements regarding noise and prioritizing heat pump use over supplemental electric resistance heating.
[17] https://neea.org/success-stories/heat-pump-water-heaters
[18] As of 12/21/23: https://neea.org/img/documents/residential-unitary-HPWH-qualified-products-list.pdf
[19] The recent DOE rulemaking references a lifetime of 14 years for gas storage water heaters and 14.8 years for electric storage water heaters. 15 years for each was used in this analysis for both types for simplification.

Table 10 presents similar costs to Table 9, except that the costs assume replacement of an existing 50-gallon electric storage water heater and does not include the 240 V electrical service cost.

Table 10. Water Heating Measure Cost Assumptions – Existing Electric Resistance

	Electric Storage Water Heater	240V Fed. Min. HPWH	240V Market Std. NEEA HPWH	240V Market Std. NEEA HPWH + DR	120V Market Std. NEEA HPWH	240V Fed. Min. HPWH, Exterior Closet	240V Fed. Min. HPWH, Interior Closet, Not Ducted	240V Fed. Min. HPWH, Interior Closet, Ducted
First Cost	$2,583	$6,413	$7,274	$7,274	$5,101	$6,413	$6,413	$7,492
Replacement Cost (Future Value)	$2,583	$6,413	$7,274	$7,274	$5,101	$6,413	$6,413	$6,413
Replacement Cost (Present Value)	$1,658	$4,116	$4,669	$4,669	$3,274	$4,116	$4,116	$4,116
Total Lifecycle Cost	$4,241	$10,529	$11,943	$11,943	$8,375	$10,529	$10,529	$11,608
Incremental Cost	-	**$6,288**	**$7,702**	**$7,702**	**$4,134**	**$6,288**	**$6,288**	**$7,367**

3 Results

The primary objective of the evaluation is to identify cost-effective energy upgrade measures and packages for existing single family buildings, to support the design of local ordinances requiring upgrades, which may be triggered by different events, such as at the time of a significant remodel or at burnout of mechanical equipment. In this report, the 1992-2010 vintage is shown for the equipment measures because it is the most conservative case (lowest loads), while the pre-1978 vintage is shown for the envelope and duct measures because some of those measures only apply to the pre-1978 vintage. A full dataset of all results can be downloaded at https://localenergycodes.com/content/resources. Results alongside policy options can also be explored using the Cost-effectiveness Explorer at https://explorer.localenergycodes.com/.

3.1 Cost-Effectiveness Results

The extensive analysis for this type of report leads to an overwhelming number of scenarios including different base cases, house vintages, replacement options, and climate zones. To simplify the reporting, the Statewide Reach Codes Team has relied on graphical representation of select key cases indicating high level measure cost effectiveness from either an On-Bill perspective, an LSC perspective, both metrics, or neither. Figure 1 through Figure 13 present this reduced set of results of the LSC and On-Bill cost-effectiveness conclusions across the 16 climate zones. In the cases where there are multiple utilities serving a single climate zone, an asterisk "*" label is added to separately show the alternate utility cases. These graphs provide a general sense of the findings. A full dataset of all results can be downloaded at https://localenergycodes.com/content/resources. Results alongside policy options can also be explored using the Cost-effectiveness Explorer at https://explorer.localenergycodes.com/.

3.1.1 HPSH Measures

Figure 1 through Figure 5 show the cost-effectiveness of space heating equipment replacement measures for the 1992-2010 vintage including the following cases. The 1992-2010 vintage results are presented here as this is the most conservative scenario for HPSH measures. In general, where a HPSH measure is cost-effective for a new home it was also found to be cost-effective for older homes.

- Dual fuel heat pump with existing furnace as backup.
- Standard efficiency ducted central heat pump replacement.
- High efficiency ducted central heat pump replacement.
- Ducted mini-split heat pump replacement.
- Standard efficiency ducted central heat pump replacement with 3kW PV system.

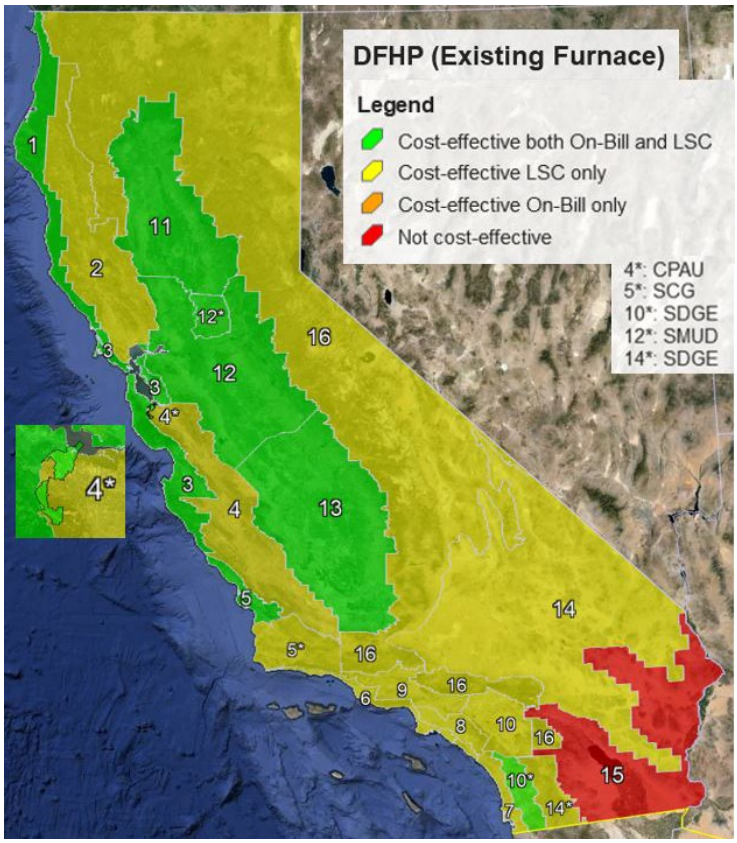


Figure 1: DFHP with Existing Furnace

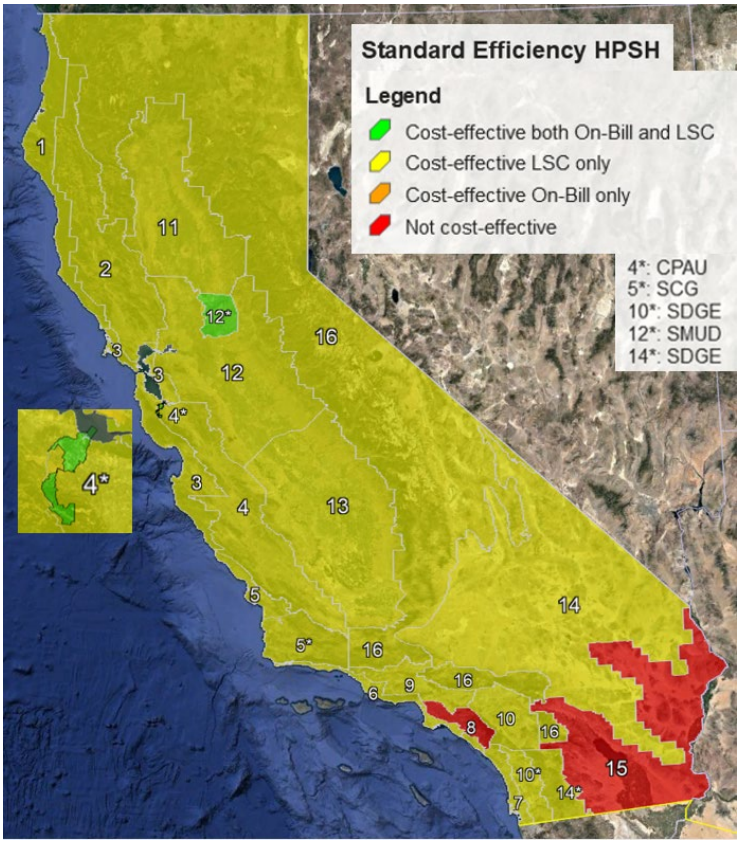


Figure 2: Standard Efficiency HPSH

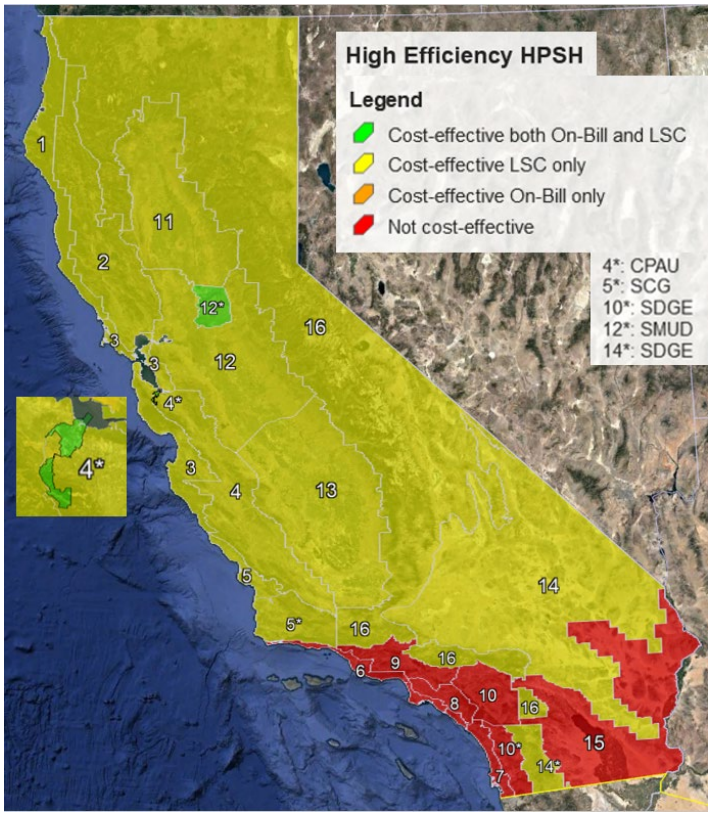


Figure 3: High Efficiency HPSH

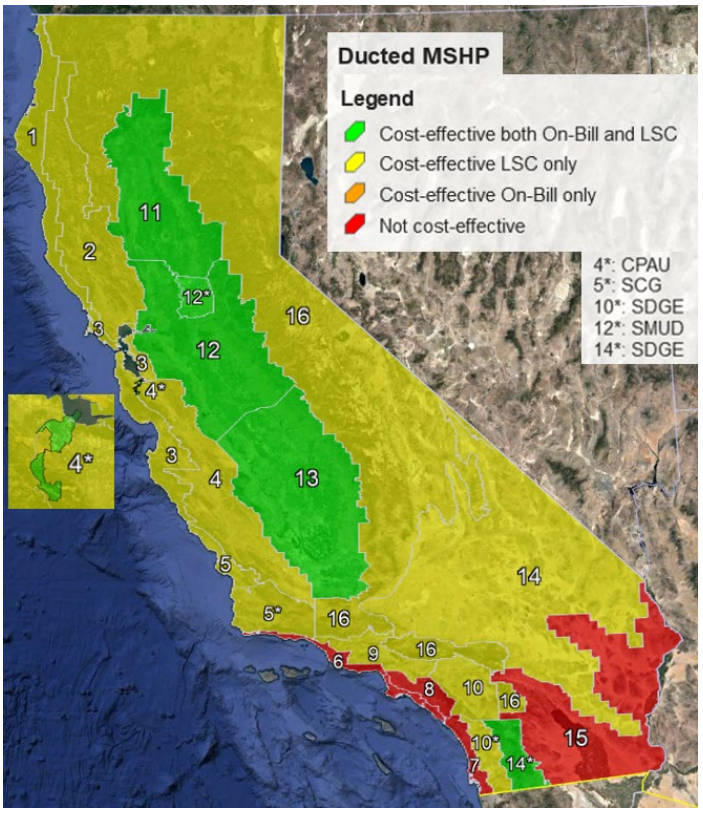


Figure 4: Ducted MSHP

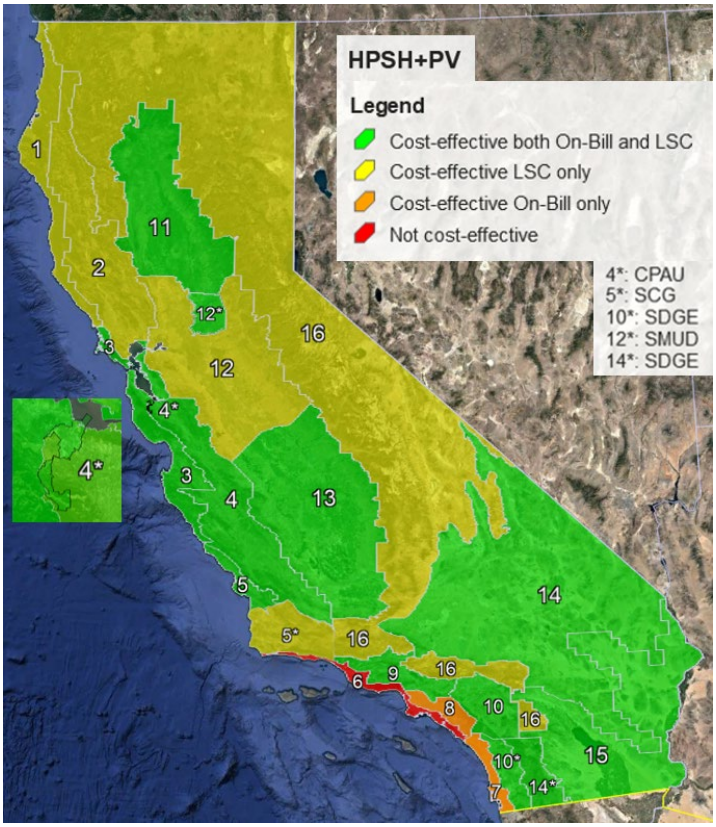


Figure 5: HPSH + PV

3.1.2 HPWH Measures

Figure 6 through Table 11 show the cost-effectiveness of water heater measures for the 1992-2010 vintage including the following cases. HPWH energy savings and LSC cost-effectiveness is not sensitive to home vintage but rather depends on the magnitude of hot water loads, which are typically driven by the number of occupants. On-Bill cost-effectiveness does vary slightly by vintage due to the impact of the electrification tariff relative to the load profile of the existing home. The impact is largest for the HPWH + PV case where On-Bill cost-effectiveness improves for older homes or homes with overall higher energy use resulting in less exports to the grid for a fixed size PV system.

- 240V federal minimum HPWH
- 240V market standard NEEA HPWH
- 120V market standard NEEA HPWH
- 240V federal minimum HPWH with 3kW PV

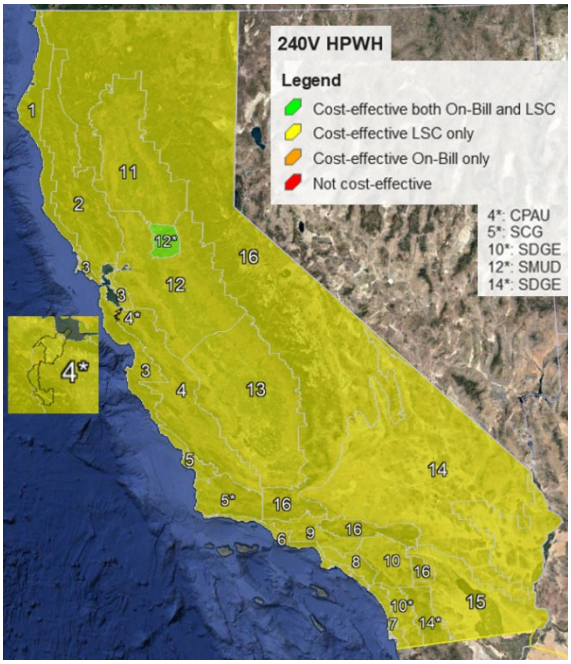


Figure 6: 240V Federal Minimum HPWH

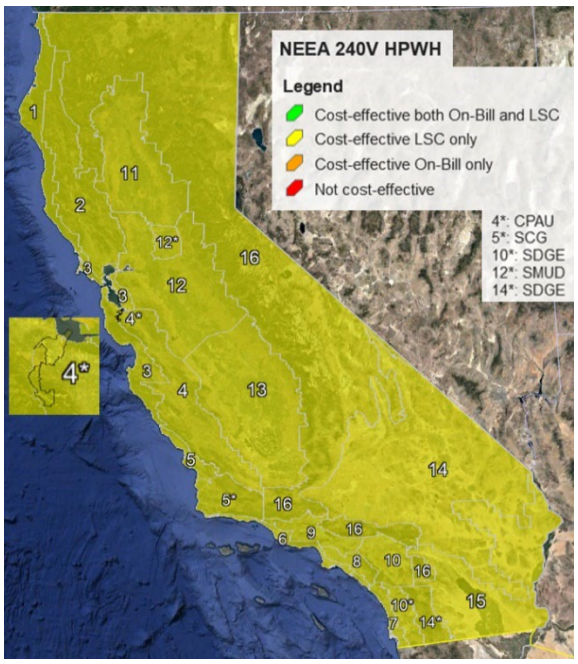


Figure 7: 240V Market Standard NEEA HPWH

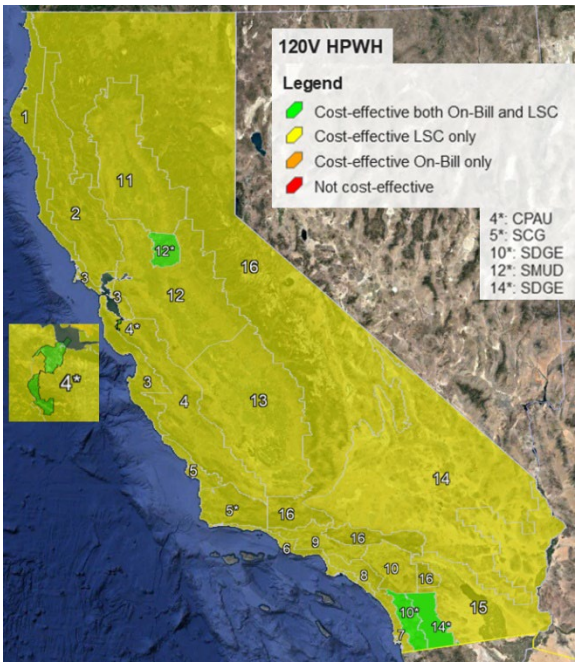


Figure 8: 120V Market Standard NEEA HPWH

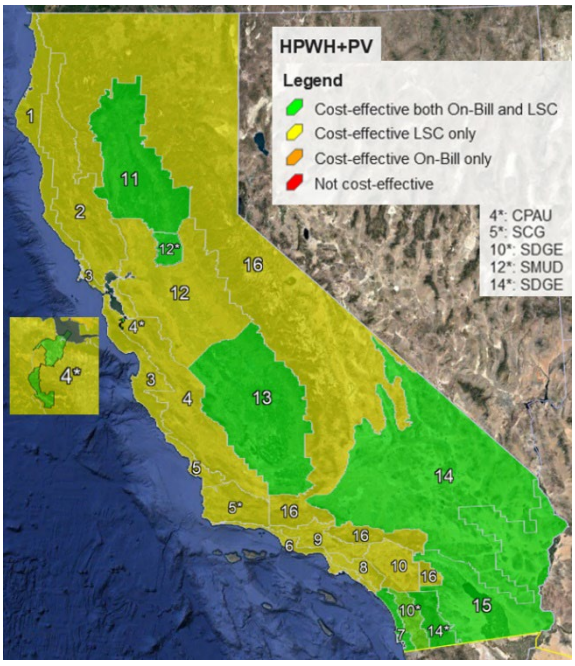
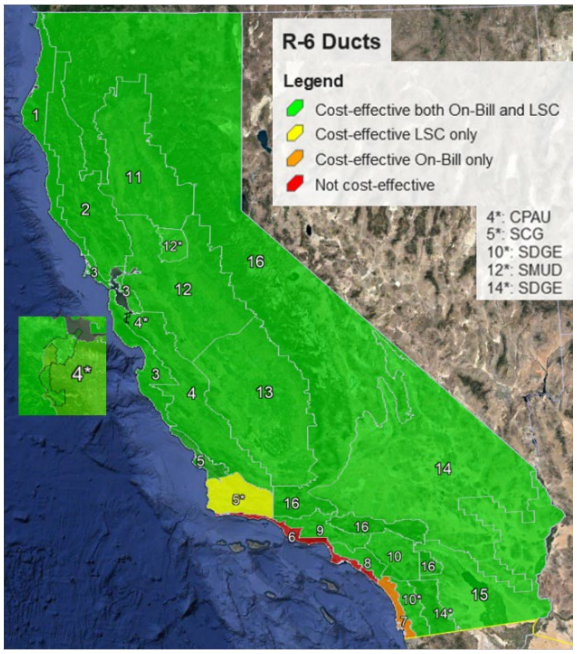


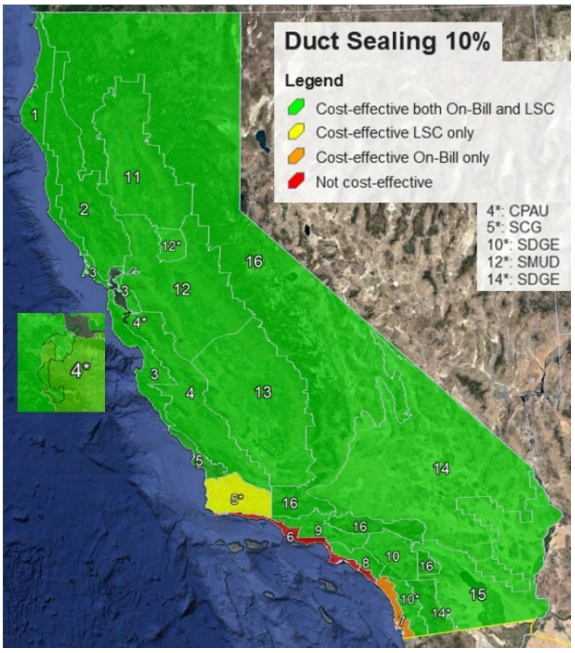
Figure 9: 240V Federal Minimum HPWH + PV

- Envelope and Duct Measures

Figure 10 through Figure 13 show the cost-effectiveness results of envelope and duct measures for the pre-1978 vintage including the following measures. The pre-1978 vintage is presented as representing the most favorable existing conditions for cost-effective upgrades. Newer homes with higher performing envelope may still benefit from these types of upgrade measures, but cost-effectiveness is reduced. Some measures, like R-13 wall insulation, aren't applicable to newer homes which would have been constructed originally with insulated walls.

- New R-6 ducts
- 10% duct leakage
- R-13 wall insulation
- R-49 attic insulation





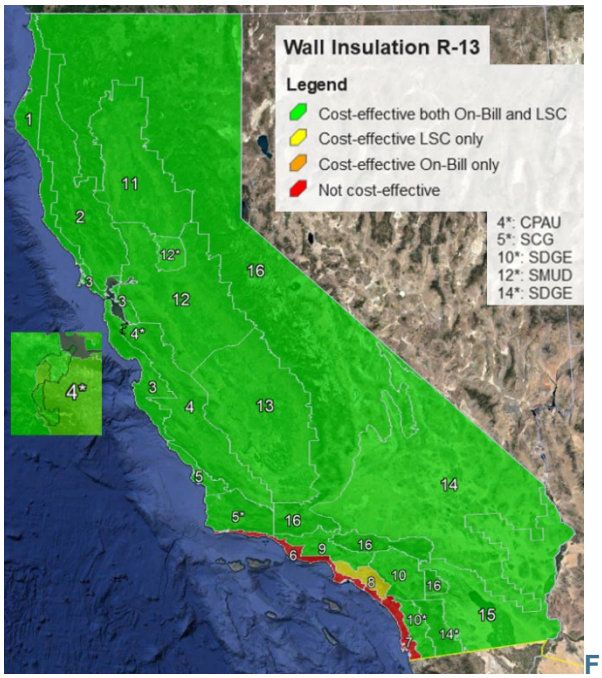


Figure 10: R-6 Ducts

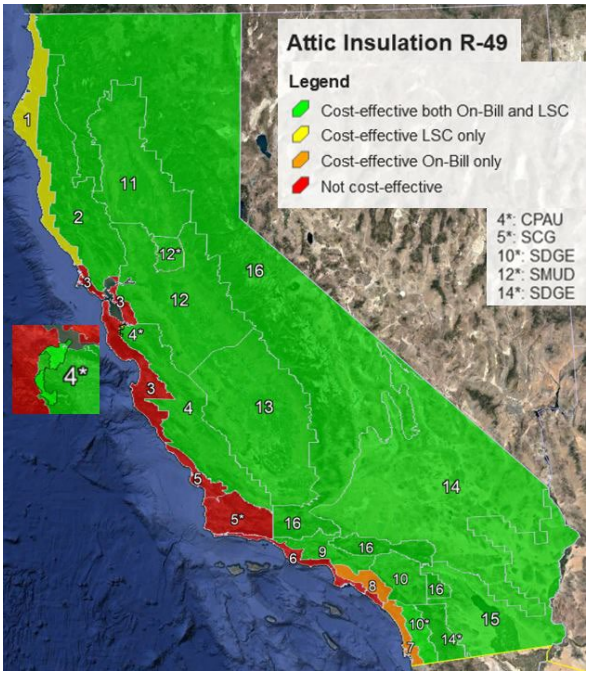


Figure 11: 10% Duct Leakage

Figure 12: R-13 Wall Insulation

Figure 13: R-49 Attic Insulation

3.2 Climate Zone Case Studies

To better understand the details of the results, a few climate zones were selected to provide a more detailed presentation of cost-effectiveness results. Section 3.2.1 through 3.2.3 show the first-year incremental cost, first-year utility savings, and NPV for a variety of cases. Section 3.2.4 shows the sensitivity of the cost effectiveness results due to varying utility escalation rates, the impact of CARE rates, future equipment cost assumptions, and the need for electrical panel upgrades. The climate zones were selected to be representative of areas of significant reach code activity. Please refer to the Cost-Effectiveness Explorer (Statewide Reach Codes, 2023) or the source dataset for the full analysis.

3.2.1 HPSH Cost-Effectiveness

Cost-effectiveness of heat pump space heating measures for Climate Zones 12 and 16 is summarized in Table 11 and Table 12 below. In Climate Zone 12, HPSH measures are cost-effective based on LSC in all cases except the ductless MSHP cases and are cost-effective On-Bill with SMUD rates in all cases except the DFHP case with a new furnace and the ductless MSHP cases. These measures are cost-effective On-Bill with PGE for the DFHP with an existing furnace and ducted MSHP measures. Climate Zone 16 provides an example of HPSH cost-effectiveness in a cold climate where almost all HPSH measures are cost effective based on LSC but not cost-effective On-Bill.

Table 11. HPSH CZ 12 [1992-2010]

Measure	First Incremental Cost	2025 LSC NPV	PGE		SMUD	
			First-year Utility Savings	On-Bill NPV	First-year Utility Savings	On-Bill NPV
DFHP Existing Furnace	$1,960	$7,093	($19)	$1,633	$247	$7,693
DFHP New Furnace	$4,023	$3,915	($34)	($3,134)	$234	$2,979
HPSH (Std Efficiency)	$1,172	$6,990	($147)	($2,151)	$246	$6,812
HPSH (High Efficiency)	$4,149	$5,366	$13	($3,368)	$300	$3,160
Ducted MSHP	$1,421	$9,136	$10	$378	$298	$6,951
Ductless MSHP (Std Efficiency)	$13,336	($9,175)	$30	($18,039)	$276	($12,428)
Ductless MSHP (High Efficiency)	$17,266	($6,753)	$409	($15,853)	$423	($15,532)
HPSH + PV	$10,780	$5,289	$452	($59)	$885	$9,821

Table 12. HPSH CZ 16 [1992-2010]

Measure	First Incremental Cost	2025 LSC NPV	PGE	
			First-year Utility Savings	On-Bill NPV
DFHP Existing Furnace	$2,397	$7,289	($116)	($1,891)
DFHP New Furnace	$4,757	$2,457	($133)	($6,322)
HPSH (Std Efficiency)	$2,725	$11,142	($480)	($8,532)
HPSH (High Efficiency)	$5,701	$12,099	($204)	($7,125)
Ducted MSHP	$2,155	$16,554	($221)	($2,853)
Ductless MSHP (Std Efficiency)	$13,336	($134)	($170)	($19,742)
Ductless MSHP (High Efficiency)	$17,266	$9,397	$539	($10,031)
HPSH + PV	$12,333	$10,640	$316	($1,949)

3.2.2 HPWH Cost-Effectiveness

Cost-effectiveness of heat pump water heating measures for Climate Zones 12 and 16 is summarized in Table 13 and Table 14 below. This sensitivity study looks at a wider range of HPWH tank locations and whether or not the unit has ducting for supply and exhaust air. All the HPWH measures in Climate Zones 12 and 16 are cost effective based on LSC.

Table 13. HPWH CZ 12 [1992-2010]

Measure	First Incremental Cost	2025 LSC NPV	PGE		SMUD	
			First-Year Utility Savings	On-Bill NPV	First-Year Utility Savings	On-Bill NPV
240V Fed. Min. HPWH	$4,332	$3,536	($213)	($8,738)	$191	$477
240V Market Std. NEEA HPWH	$5,193	$4,304	($82)	($7,164)	$230	($56)
240V Market Std. NEEA HPWH + DR	$5,193	$5,536	($21)	($5,773)	$248	$362
120V Market Std. NEEA HPWH	$2,893	$9,730	($2)	($1,651)	$254	$4,203
240V Fed. Min. HPWH (Exterior Closet)	$4,751	$2,834	($224)	($9,431)	$186	($78)
240V Fed. Min. HPWH (Interior Closet)	$4,413	$3,123	($71)	($6,138)	$188	($235)
240V Fed. Min. HPWH (Interior Closet, ducted)	$5,492	$3,359	($202)	($9,505)	$205	($231)
240V Fed. Min. HPWH + PV	$13,940	$3,567	$577	($2,300)	$831	$3,486

Table 14. HPWH CZ 16 [1992-2010]

Measure	First Incremental Cost	2025 LSC NPV	PGE	
			First-Year Utility Savings	On-Bill NPV
240V Fed. Min. HPWH	$4,332	$4,186	($250)	($9,307)
240V Market Std. NEEA HPWH	$5,193	$4,088	($160)	($8,652)
240V Market Std. NEEA HPWH + DR	$5,193	$5,653	($79)	($6,804
120V Market Std. NEEA HPWH	$2,893	$10,646	($13)	($1,602)
240V Fed. Min. HPWH (Exterior Closet)	$4,751	$3,317	($268)	($10,154)
240V Fed. Min. HPWH (Interior Closet)	$4,413	$5,004	($18)	($4,690)
240V Fed. Min. HPWH (Interior Closet, ducted)	$5,492	$4,857	($202)	($9,174)
240V Fed. Min. HPWH + PV	$13,940	$5,049	$620	($1,043)

3.2.3 Envelope & Duct Improvement Cost-Effectiveness

Cost-effectiveness of envelope and duct measures for Climate Zones 3, 10, and 12 is summarized in Table 15 through Table 17.

Table 15. Envelope and Duct Measures CZ 3 [Pre-1978]

Measure	First Incremental Cost	2025 LSC NPV	PG&E	
			First-year Utility Savings	On-Bill NPV
R-6 Ducts	$4,808	$2,851	$188	$463
R-8 Ducts	$6,311	$1,747	$198	($776)
10% Duct Sealing	$2,590	$1,956	$104	$397
R-13 Wall Insulation	$2,950	$3,476	$144	$1,221
R-38 Attic Insulation	$6,762	($1,567)	$127	($3,178)
R-49 Attic Insulation	$7,446	($1,768)	$139	($3,520)
R-30 Raised Floor Insulation	$4,113	$9,008	$224	$2,975
Cool Roof (0.20 Ref)	$893	($2,419)	($18)	($1,811)

Table 16. Envelope and Duct Measures CZ 10 [Pre-1978]

Measure	First Incremental Cost	2025 LSC NPV	SCE/SCG		SDGE	
			First-year Utility Savings	On-Bill NPV	First-year Utility Savings	On-Bill NPV
R-6 Ducts	$4,808	$7,463	$783	$13,168	$1,100	$22,155
R-8 Ducts	$6,311	$6,326	$800	$12,076	$1,125	$21,268
10% Duct Sealing	$2,590	$3,438	$370	$5,969	$518	$10,166
R-13 Wall Insulation	$2,950	$1,795	$179	$1,476	$250	$3,494
R-38 Attic Insulation	$6,762	$664	$416	$2,951	$582	$7,654
R-49 Attic Insulation	$7,446	$796	$467	$3,435	$655	$8.756
R-30 Raised Floor Insulation	$4,113	($999)	($29)	($4,235)	($46)	($4,687)
Cool Roof (0.20 Ref)	$893	$428	$174	$2,647	$246	$4,656

Table 17. Envelope and Duct Measures CZ 12 [Pre-1978]

Measure	First Incremental Cost	2025 LSC NPV	PG&E		SMUD	
			First-year Utility Savings	On-Bill NPV	First-year Utility Savings	On-Bill NPV
R-6 Ducts	$4,808	$11,609	$804	$14,727	$413	$5,816
R-8 Ducts	$6,311	$10,722	$828	$13,849	$427	$4,711
10% Duct Sealing	$2,590	$6,418	$397	$7,280	$222	$3,281
R-13 Wall Insulation	$2,950	$5,774	$262	$4,054	$187	$2,342
R-38 Attic Insulation	$6,762	$3,727	$499	$5,461	$261	$19
R-49 Attic Insulation	$7,446	$4,092	$552	$6,063	$288	$33
R-30 Raised Floor Insulation	$4,113	$5,245	$27	($1,176)	$156	$1,175
Cool Roof (0.20 Ref)	$893	($354)	$154	$2,123	$44	($386)

3.2.4 Sensitivities

Table 18 shows the On-Bill NPV results of Climate Zone 12 with PG&E utility rates and the impacts of escalation rates, and CARE rates. The "Standard Results" in Table 18 assumes the escalation rates used in the analysis presented elsewhere in this report. Table 19 shows the impact of electrical panel upgrades. The "Standard Results" in Table 19 does not assume a panel upgrade is required.

Table 18. Sensitivity Analysis Results for On-Bill NPV Cost-Effectiveness in Climate Zone 12, PG&E

Measure	Vintage	Standard Results	2025 LSC Escalation	CARE
DFHP Existing Furnace	1992-2010	$1,063	$8,443	$1,884
DFHP New Furnace	1992-2010	($6,770)	$383	($5,846)
HPSH (Std Efficiency)	1992-2010	($2,151)	$6,011	($220)
HPSH (High Efficiency)	1992-2010	($3,368)	$4,987	($2,721)
Ducted MSHP	1992-2010	$378	$8,729	$1,057
Ductless MSHP (Std Efficiency)	1992-2010	($18,039)	($10,732)	($17,623)
Ductless MSHP (High Efficiency)	1992-2010	($15,853)	($8,091)	($18,460)
HPSH + PV	1992-2010	($59)	$8,822	($1,255)
240V Fed. Min. HPWH	1992-2010	($8,738)	($2,433)	($6,448)
240V Market Std. NEEA HPWH	1992-2010	($7,164)	($694)	($5,918)
240V Market Std. NEEA HPWH + DR	1992-2010	($5,773)	$770	(5,014)
120V Market Std. NEEA HPWH	1992-2010	($1,651)	$4,930	(1,038)
240V Fed. Min. HPWH (Exterior Closet)	1992-2010	($9,431)	($3,184)	($7,055)
240V Fed. Min. HPWH (Interior Closet)	1992-2010	($6,138)	($1,000)	($5,098)
240V Fed. Min. HPWH (Interior Closet, ducted)	1992-2010	($9,505)	($2,836)	($7,271)
240V Fed. Min. HPWH + PV	1992-2010	($2,300)	$4,952	($4,858)
R-6 Ducts	Pre-1978	$14,727	$18,685	$8,592
R-8 Ducts	Pre-1978	$13,849	$17,990	$7,532
10% Duct Sealing	Pre-1978	$7,280	$9,752	$4,294
R-13 Wall Insulation	Pre-1978	$4,054	$6,898	$2,196
R-38 Attic Insulation	Pre-1978	$5,461	$8,126	$1,668
R-49 Attic Insulation	Pre-1978	$6,063	$8,978	$1,864
R-30 Raised Floor Insulation	Pre-1978	($1,776)	$2,468	($1,602)
Cool Roof (0.20 Ref)	Pre-1978	$2,123	$1,848	$851

Table 19. Electric Panel Upgrade Sensitivity for CZ 12 [1992-2010]

Measure	Standard Results		Electric Panel Upgrade	
	On-Bill NPV	LSC NPV	On-Bill NPV	LSC NPV
HPSH (Std Efficiency)	($2,151)	$6,990	($4,931)	$4,210
240V Fed. Min. HPWH	($8,738)	$3,536	($11,624)	$756

3.3 Gas Pathways for Heat Pump Replacements

Many jurisdictions are exploring policy options to accelerate the decarbonization of existing homes. A recent Ninth Circuit Court ruling in *California Rest. Ass'n v. City of Berkeley*[20] invalidated Berkeley's ordinance banning the installation of gas infrastructure in new construction. The ruling stated that the ordinance effectively banned covered products and was preempted by the Energy Policy and Conservation Act ("EPCA"), 42 U.S.C. § 6297(c). Given the possible impacts of that ruling, the Reach Codes Team analyzed policy options targeting equipment replacements that allow for the installation of either electric or gas-fueled equipment. These packages include gas equipment combined with additional efficiency measures resulting in options that are reasonably energy or LSC cost equivalent, to the extent feasible.

For space heating, the heat pump path is a DFHP (existing furnace).. The gas pathway is a new air conditioner with the following list of efficiency upgrades:

- 400 cfm/ton system airflow (HERS verified).
- 0.35 W/cfm fan efficacy (HERS verified).
- Refrigerant charge verification (HERS verified).
- R-8 ducts, 5% leakage (HERS verified).
- R-49 (from R-30) attic insulation.
- Air sealing of the ceiling from 7 to 6.5 ACH50.

The two pathways are presented in Figure 14 comparing total LSC energy use relative to the existing home for the 1992-2010 vintage. In most climate zones, the DFHP (existing furnace) path results in higher energy savings, in the milder climates the air conditioner path saves marginally more energy. A reach code that establishes requirements when an air conditioner is replaced or installed new, could allow for either a heat pump to be installed or an air conditioner as long as the performance measures listed above are met. Note that in this analysis a DFHP (existing furnace) was used; however, a reach code could require a different heat pump measure for the heat pump path. This approach aligns with the CEC's proposal for the 2025 Title 24 code cycle for heat pump alterations in single family homes (California Energy Commission, 2023).

[20] *California Rest. Ass'n v. City of Berkeley*, 65 F.4th 1045 (9th Cir. 2023) amended by 89 F.4th 1094 (9th Cir. 2024).

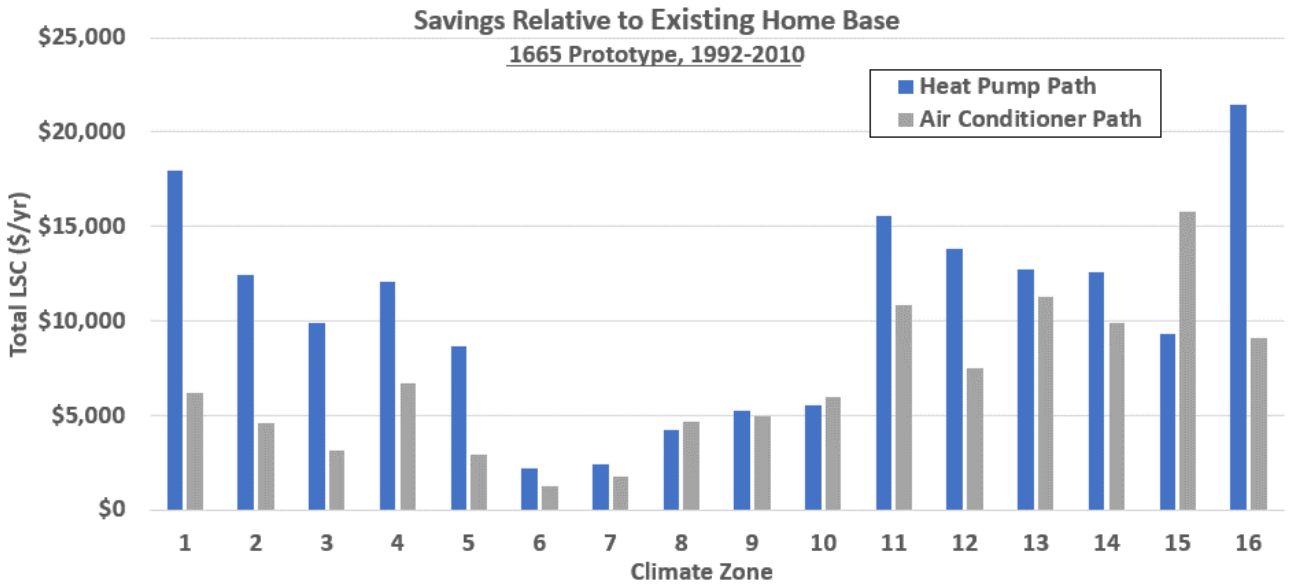


Figure 14. Heat pump space heater path compared to the air conditioner path.

For water heating, the federal minimum HPWH case was used to develop the package. The HPWH was compared to a new gas storage water heater with a 50% solar thermal backup system.

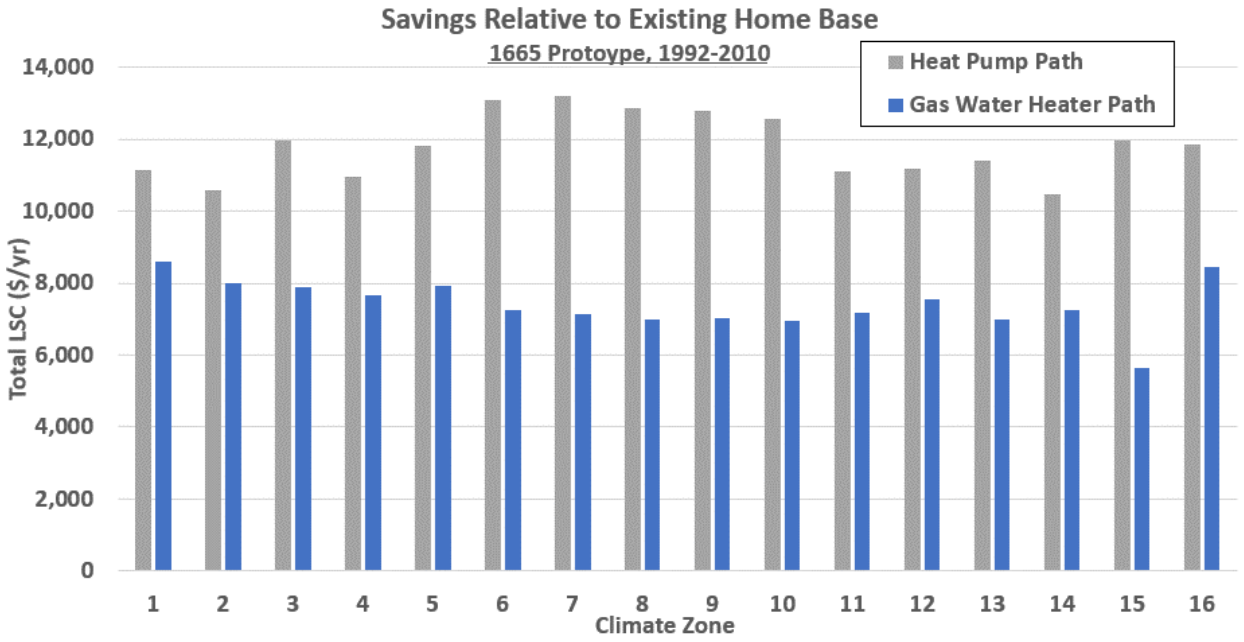


Figure 15. Heat pump water path compared to gas with solar thermal.

The two pathways are presented in Figure 15 comparing total LSC energy use relative to the existing home for the 1992-2010 vintage. In all climate zones, the heat pump path results in higher energy savings than the gas path. A reach code that establishes requirements when a water heater is replaced could allow for either a HPWH to be installed or a gas water heater in combination with a solar thermal system that meets the solar fraction requirements listed above.

4 Recommendations and Discussion

This analysis evaluated the feasibility and cost-effectiveness of retrofit measures in California existing homes built before 2010. The Statewide Reach Codes Team used both On-Bill and LSC-based LCC approaches to evaluate cost-effectiveness and quantify the energy cost savings associated with energy efficiency measures compared to the incremental costs associated with the measures.

Conclusions and Discussion:

1. Envelope measures. Improving envelope performance is very cost-effective in many older homes. In addition to reducing utility costs these measures provide many other benefits such as improving occupant comfort and satisfaction and increasing a home's ability to maintain temperatures during extreme weather events and power outages. Below is a discussion of the results of specific measures.
    a. Adding attic insulation is cost effective based on both LSC and On-Bill in many climate zones in homes with no more than R-19 existing attic insulation levels. Increasing attic insulation from R-30 to R-49 was still found to be cost-effective based on at least one metric in the colder and hotter climates of Climate Zone 10 (SDG&E territory only) through 16.
    b. Insulating existing uninsulated walls is very cost-effective based on both metrics everywhere except Climate Zones 6 and 7 (in Climate Zone 8 it's only cost-effective based on LSC).
    c. Adding R-19 or R-30 floor insulation is cost-effective based on LSC in the older two vintages (Pre-1978 and 1978-1991) in all climate zones except Climate Zones 6-10.
    d. Replacing old single pane windows with new high-performance windows has a very high cost and is typically not done for energy savings alone. However, energy savings are substantial and justify cost-effectiveness of this measure based on at least one metric in Climate Zones 4, 8 through 12 (PG&E territory only), and 13 through 16.
    e. At time of roof replacement, a cool roof with an aged solar reflectance of 0.25 was found to be cost-effective in Climate Zones 4, 6 through 12 (PG&E territory only), and 13 through 15. When the roof deck is replaced during a roof replacement, adding a radiant barrier is low cost and provides substantial cooling energy savings to be cost-effective in almost all climate zones and homes.
2. Duct measures: Many older homes have old, leaky duct systems that should be replaced when they reach the end of life, typically 20-30 years. In this case, installing new ducts was found to be cost-effective based on at least one metric (both in most cases) everywhere except mild Climate Zone 7 and Climate Zones 5 and 6 in the 1978-1991 vintage. If duct systems still have remaining life they should be sealed and tested to meet 10% leakage or lower; however, duct upgrades alone were only found to be cost-effective for newer homes in Climate Zones 10 (SDG&E territory only), 11, and 13 through 16. Duct upgrades may be able to be coupled with other measures to reduce the cost.
3. Heat pump space heating: HPSHs were found to be LSC cost-effective in many cases. The DFHP (existing furnace) was LSC cost-effective everywhere except Climate Zone 15. The HPSH was LSC cost-effective everywhere except Climate Zones 8 and 15.
    a. Challenges to On-Bill cost-effectiveness include higher first costs and higher first-year utility costs due to higher electricity tariffs relative to gas tariffs. SMUD and CPAU are two exceptions where first year utility costs are lower for heat pumps than for gas equipment. Table 11 shows the impact of utility rates on cost-effectiveness of HPSH where the standard and high efficiency HPSH and the HPSH + PV measures are cost-effective under SMUD but not PG&E. Even with higher first year utility bills, there were some cases that still proved On-Bill cost-effective including the DFHP with an existing furnace in the central valley and northern coastal PG&E territories, the ducted MSHP in the central valley as well as Climate Zone 14 in SDG&E territory, and the HPSH + PV measure in CZ 3-5 (PGE), 7-11, and 12 (SMUD) – 15.
    b. The ductless MSHPs, evaluated for homes with existing ductless systems, were only found to be cost-effective based on either metric in Climate Zones 1 and 16. Ductless MSHPs have a high incremental cost because it is a more sophisticated system than the base model of a wall furnace with a window AC unit. However, the ductless MSHP would provide greater comfort benefits if properly installed to

directly condition all habitable spaces (as is required under the VCHP compliance credit as evaluated in this study) which may be an incentive for a homeowner to upgrade their system.

c. Higher efficiency equipment lowered utility costs in all cases and improved cost-effectiveness in many cases, particularly with a ducted MSHP.

4. Heat pump water heating: All the HPWH measures were LSC cost-effective in all climate zones. Most measures were not On-Bill cost-effective with the exception of the HPWH + PV which was cost-effective On-Bill in CPAU, SMUD, and SDG&E territories in addition to Climate Zones 11, 13, 14, and 15. The HPWH measures share many of the same challenges as the HPSH measures to achieving cost-effectiveness including high first costs and utility rates and assumptions. Table 13 shows the impact of utility rates on cost-effectiveness where some HPWH measures are cost-effective under SMUD utility rates but are not cost-effective anywhere under PG&E rates in Climate Zone 12.
    a. Various HPWH locations were also explored, however there are some factors outside of cost-effectiveness that should also be considered.
        i. HPWHs in the conditioned space can provide benefits such as free cooling during the summer, reduced tank losses, and shorter pipe lengths, and in some cases show improved cost-effectiveness over garage located HPWHs. However, there are various design considerations such as noise, comfort concerns, and condensate removal. Ducting the inlet and exhaust air resolves comfort concerns but adds costs and complexity. Split heat pump water heaters address these concerns, but currently there are limited products on the market and there is a cost premium relative to the packaged products.
        ii. Since HPWHs extract heat from the air and transfer it to water in the storage tank, they must have adequate ventilation to operate properly. Otherwise, the space cools down over time, impacting the HPWH operating efficiency. This is not a problem with garage installations but needs to be considered for water heaters located in interior or exterior closets. For the 2025 Title 24 code the CEC is proposing that all HPWH installations meet mandatory ventilation requirements (California Energy Commission, 2023).
5. The contractor surveys revealed overall higher heat pump costs than what has been found in previous analyses. This could be due to incentive availability raising demand for heat pumps and thereby increasing the price. This price increase may be temporary and may come down once the market stabilizes. There are also new initiatives to obtain current costs including the TECH Clean California program[21] that publishes heat pump data and costs; however, at the time of this analysis, the TECH data did not contain incremental costs because it only had the heat pump costs but not the gas base case costs.
6. Table 18 shows how CARE rates and escalation rate assumptions will impact cost-effectiveness.
    a. Applying CARE rates in the IOU territories has the overall impact to increase utility cost savings for an all-electric building compared to a code compliant mixed fuel building, improving On-Bill cost-effectiveness. This is due to the CARE discount on electricity being higher than that on gas. The reverse occurs with efficiency measures where lower utility rates reduce savings and subsequently reduce cost-effectiveness.
    b. If gas tariffs are assumed to increase substantially over time, in-line with the escalation assumption from the 2025 LSC development, cost-effectiveness substantially improves for the heat pump measures over the 30-year analysis period and many cases become cost-effective that were not found to be cost-effective under the CPUC / 2022 TDV escalation scenario. There is much uncertainty surrounding future tariff structures as well as escalation values. While it's clear that gas rates will increase, how much and how quickly is not known. Future electricity tariff structures are expected to evolve over time, and the CPUC has an active proceeding to adopt an income-graduated fixed charge that benefits low-income customers and supports electrification measures for all customers.[22] The CPUC will decide in mid-2024 and the new rates are expected to be in place later that year or in 2025.

[21] TECH Public Reporting Home Page (techcleanca.com)
[22] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking

While the anticipated impact of this rate change is lower volumetric electricity rates, the rate design is not finalized. While lower volumetric electricity rates provide many benefits, it also will make building efficiency measures harder to justify as cost-effective due to lower utility bill cost savings.

7. Under NBT, utility cost savings for PV are substantially less than what they were under prior net energy metering rules (NEM 2.0); however, savings are sufficient to be On-Bill cost-effective in all climate zones except Climate Zones 1 through 3 and 5 through 6.
    a. Combining a heat pump with PV allows the additional electricity required by the heat pump to be offset by the PV system while also increasing on-site utilization of PV generation rather than exporting the electricity back to the grid at a low rate.
    b. While not evaluated in this study, coupling PV with battery systems can be very advantageous under NBT increasing utility cost savings because of improved on-site utilization of PV generation and fewer exports to the grid.

Recommendations:

1. There are various approaches for jurisdictions who are interested in reach codes for existing buildings. Some potential approaches are listed below along with key considerations.
    a. Prescriptive measures: Non-preempted measures that are found to be cost-effective may be prescriptively required in a reach code. One example of this type or ordinance is a cool roof requirement at time of roof replacement. Another example is requiring specific cost-effective measures for larger remodels, such as high-performance windows when new windows are installed or duct sealing and testing where ducts are in unconditioned space.
    b. Replacement equipment: This flavor of reach code sets certain requirements at time of equipment replacement. This study evaluated space heating and water heating equipment. Where a heat pump measure was found to be cost-effective based on either LSC or On-Bill, this may serve as the basis of a reach code given the following considerations.
        i. Where reach codes reduce energy usage and are not just fuel switching, cost-effectiveness calculations are required and must be based on equipment that does not exceed the federal minimum efficiency requirements.
        ii. Where reach codes are established using cost-effectiveness based on LSC, utility bill impacts and the owner's first cost should also be reviewed and considered.
        iii. A gas path should also be prescriptively allowed to safely satisfy federal preemption requirements considering the CRA v. Berkeley case.[23] Additional requirements may apply to the gas path, as described in Section 3.3, as long as the paths are reasonably energy or cost equivalent.
    c. "Flexible Path", minimum energy savings target: This flexible approach establishes a target for required energy savings based on a measure or a set of measures that were found to be cost-effective based on either LSC or On-Bill. A points menu compares various potential upgrades ranging from efficiency, PV, and fuel substitution measures, based on site or source energy savings. The applicant must select upgrades that individually or in combination meet the minimum energy savings target. The measures used to set the target should be non-preempted measures.
2. Equipment replacement ordinances should consider appropriate exceptions for scenarios where it will be challenging to meet the requirements, such as location of the HPWH, total project cost limitations, or the need for service panel upgrades that wouldn't have been required as part of the proposed scope of work in absence of the reach code.
3. Consider extending relevant proposals made by the CEC for the 2025 Title 24 code (California Energy Commission, 2023) in ordinances that apply under the 2022 Title 24 code, such as the following:
    a. Mandatory ventilation requirements for HPWH installations (Section 110.3(c)7).

[23] https://www.publichealthlawcenter.org/sites/default/files/2024-01/CRA-v-Berkeley-Ninth-Circuit-Opinion-Jan2024.pdf

   b. Requirement for HERS verified refrigerant charge verification for heat pumps in all climate zones (Table 150.1-A[24]).
4. When evaluating reach code strategies, the Reach Codes Team recommends that jurisdictions consider combined benefits of energy efficiency alongside electrification. Efficiency and electrification have symbiotic benefits and are both critical for decarbonization of buildings. As demand on the electric grid is increased through electrification, efficiency can reduce the negative impacts of additional electricity demand on the grid, reducing the need for increased generation and storage capacity, as well as the need to upgrade upstream transmission and distribution equipment.
5. Education and training can play a critical role in ensuring that heat pumps are installed, commissioned, and controlled properly to mitigate grid impacts and maximize occupant satisfaction. Below are select recommended strategies.
   a. The Quality Residential HVAC Services Program[25] is an incentive program to train California contractors in providing quality installation and maintenance while advancing energy-efficient technologies in the residential HVAC industry. Jurisdictions can market this to local contractors to increase the penetration of contractors skilled in heat pump design and installation.
   b. Educate residents and contractors of available incentives, tax credits, and financing opportunities.
   c. Educate contractors on code requirements. Energy Code Ace provides free tools, trainings, and resource to help Californians comply with the energy code. Contractors can access interactive compliance forms, fact sheets, and live and recorded trainings, among other things, on the website: https://energycodeace.com/. Jurisdictions can reach out to Energy Code Ace directly to discuss offerings.
6. Health and safety
   a. Combustion Appliance Safety and Indoor Air Quality: Implementation of some of the recommended measures will affect the pressure balance of the home which can subsequently impact the safe operation of existing combustion appliances as well as indoor air quality. Buildings with older gas appliances can present serious health and safety problems which may not be addressed in a remodel if the appliances are not being replaced. It is recommended that the building department require inspection and testing of all combustion appliances located within the pressure boundary of the building after completion of retrofit work that involves air sealing or insulation measures.
   b. Jurisdictions may consider requiring mechanical ventilation in homes where air sealing has been conducted. In older buildings, outdoor air is typically introduced through leaks in the building envelope. After air sealing a building, it may be necessary to forcefully bring in fresh outdoor air using supply and/or exhaust fans to minimize potential issues associated with indoor air quality.

[24] This requirement does not show up in the Express Terms for alterations in Section 150.2(b)1F, but the Statewide Reach Codes Team expects that it will be added to the next release of the proposed code language in the 45-day language as it aligns with the proposal made by the Codes and Standards Enhancement Team (Statewide CASE Team, 2023).
[25] https://qualityhvac.frontierenergy.com/

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6 Appendices

6.1 Map of California Climate Zones

Climate zone geographical boundaries are depicted in Figure 16. The map in Figure 16 along with a zip-code search directory is available at: https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html

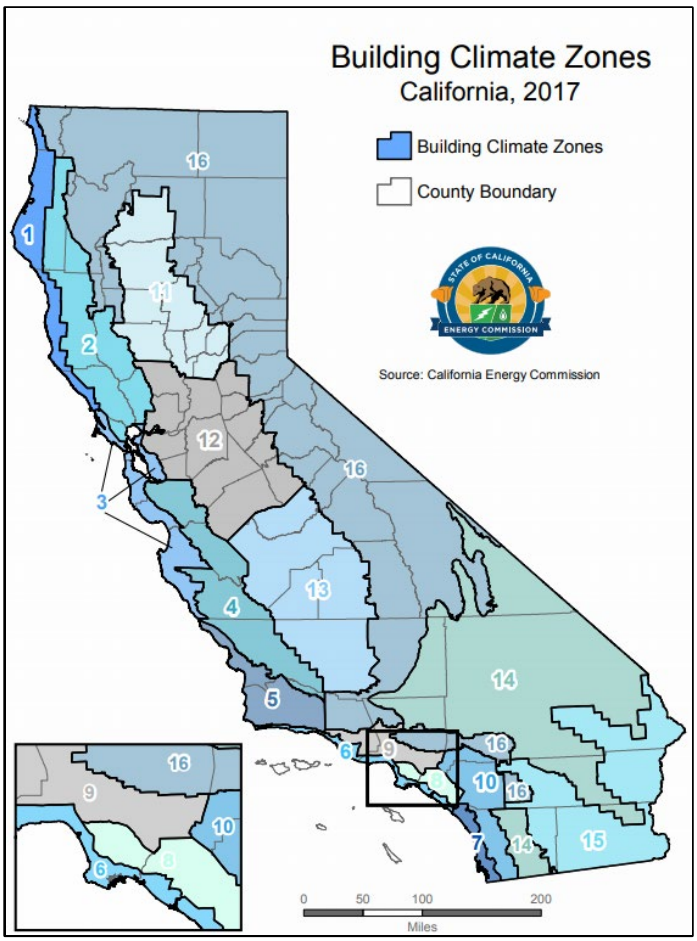

Figure 16. Map of California climate zones.

6.2 Utility Rate Schedules

The Reach Codes Team used the CA IOU and POU rate tariffs detailed below to determine the On-Bill savings for each package. The California Climate Credit was applied for both electricity and natural gas service for the IOUs using the 2023 credits shows below.[26] The credits were applied to reduce the total calculated annual bill, including any fixed fees or minimum bill amounts.

2023 Electric California Climate Credit Schedule

	February or March	April	May	June	July	Aug	Sept	Oct
PG&E	$38.39							$38.39
SCE	$71.00							$71.00
SDG&E	$60.70							$60.70

Residential Natural Gas California Climate Credit

In 2023, the 2023 Natural Gas California Climate Credit will be distributed in February or March instead of April.

	2018‡	2019	2020	2021	2022	2023	Total Value Received Per Household 2018-2023
PG&E	$30	$25	$27	$25	$48	$52.78	**$208**
SDG&E	*	$34	$21	$18	$43	$43.40	**$162**
Southwest Gas	$22	$25	$27	$28	$49	$56.35	**$207**
SoCalGas	*	$50	$26	$22	$44	$50.77	**$194**

Electricity rates reflect the most recently approved tariffs. Monthly gas rates were estimated based on recent gas rates (November 2023) and a curve to reflect how natural gas prices fluctuate with seasonal supply and demand. The seasonal curve was estimated from monthly residential tariffs between 2014 and 2023 (between 2017 and 2023 for CPAU). 12-month curves were created from monthly gas rates for each of the ten years (Seven years for CPAU). These annual curves were then averaged to arrive at an average normalized annual curve. This was conducted separately for baseline and excess energy rates. Costs used in this analysis were then derived by establishing the most recent baseline and excess rate from the latest tariff as a reference point (November 2023), and then using the normalized curve to estimate the cost for the remaining months relative to the reference point rate.

[26] https://www.cpuc.ca.gov/industries-and-topics/natural-gas/greenhouse-gas-cap-and-trade-program/california-climate-credit

6.2.1 Pacific Gas & Electric

The following pages provide details on the PG&E electricity and natural gas tariffs applied in this study. Table 20 describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of $0.07051/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between December 2022 and November 2023.

Table 20. PG&E Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ01	V
CZ02	X
CZ03	T
CZ04	X
CZ05	T
CZ11	R
CZ12	S
CZ13	R
CZ16	Y

The PG&E monthly gas rate in $/therm was applied on a monthly basis according to the rates shown in Table 21. These rates are based on applying a normalization curve to the November 2023 tariff based on ten years of historical gas data. Corresponding CARE rates reflect the 20 percent discount per the GL-1 tariff.

Table 21. PG&E Monthly Gas Rate ($/therm)

Month	Total Charge	
	Baseline	Excess
January	$2.05	$2.43
February	$2.08	$2.46
March	$1.92	$2.31
April	$1.80	$2.20
May	$1.77	$2.18
June	$1.78	$2.18
July	$1.80	$2.20
August	$1.85	$2.26
September	$1.92	$2.33
October	$1.99	$2.40
November	$2.06	$2.46
December	$2.05	$2.44

Residential
GAS
Baseline Territories and Quantities [1/]

Effective April 1, 2022 - Present

BASELINE QUANTITIES (Therms **Per Day** Per Dwelling Unit)

Individually Metered			
Baseline Territories	**Summer (April-October) Effective Apr. 1, 2022**	**Winter Off-Peak (Nov, Feb, Mar) Effective Nov. 1, 2022**	**Winter On-Peak (Dec, Jan) Effective Dec. 1, 2022**
P	0.39	1.88	2.19
Q	0.56	1.48	2.00
R	0.36	1.24	1.81
S	0.39	1.38	1.94
T	0.56	1.31	1.68
V	0.59	1.51	1.71
W	0.39	1.14	1.68
X	0.49	1.48	2.00
Y	0.72	2.22	2.58

Master Metered			
Baseline Territories	**Summer (April-October) Effective Apr. 1, 2022**	**Winter Off-Peak (Nov, Feb, Mar) Effective Nov. 1, 2022**	**Winter On-Peak (Dec, Jan) Effective Dec. 1, 2022**
P	0.29	1.01	1.13
Q	0.56	0.67	0.77
R	0.33	0.87	1.16
S	0.29	0.61	0.65
T	0.56	1.01	1.10
V	0.59	1.28	1.32
W	0.26	0.71	0.87
X	0.33	0.67	0.77
Y	0.52	1.01	1.13

Summer Season: Apr-Oct
Winter Off-Peak: Nov, Feb, Mar
Winter On-Peak: Dec, Jan

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Pacific Gas and Electric Company
U 39 Oakland, California

Revised Cal. P.U.C. Sheet No. 56550-E
Cancelling Revised Cal. P.U.C. Sheet No. 56229-E

ELECTRIC SCHEDULE E-TOU-C Sheet 2
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

RATES: (Cont'd.)

E-TOU-C TOTAL BUNDLED RATES

Total Energy Rates ($ per kWh)	PEAK		OFF-PEAK	
Summer				
Total Usage	$0.53933	(I)	$0.45589	(I)
Baseline Credit (Applied to Baseline Usage Only)	($0.08851)	(R)	($0.08851)	(R)
Winter				
Total Usage	$0.43662	(I)	$0.40827	(I)
Baseline Credit (Applied to Baseline Usage Only)	($0.08851)	(R)	($0.08851)	(R)
Delivery Minimum Bill Amount ($ per meter per day)	$0.37612			
California Climate Credit (per household, per semi-annual payment occurring in the March* and October bill cycles)	($38.39)			

Total bundled service charges shown on customer's bills are unbundled according to the component rates shown below. Where the delivery minimum bill amount applies, the customer's bill will equal the sum of (1) the delivery minimum bill amount plus (2) for bundled service, the generation rate times the number of kWh used. For revenue accounting purposes, the revenues from the delivery minimum bill amount will be assigned to the Transmission, Transmission Rate Adjustments, Reliability Services, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges, Energy Cost Recovery Amount, Wildfire Fund Charge, and New System Generation Charges based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.

* Pursuant to D.23-02-014, disbursement of the April 2023 residential Climate Credit shall begin by March 1, 2023.

(Continued)

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Pacific Gas and Electric Company
U 39 Oakland, California

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Cancelling Revised Cal. P.U.C. Sheet No. 56230-E

ELECTRIC SCHEDULE E-TOU-C Sheet 3
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

RATES: (Cont'd.)

UNBUNDLING OF E-TOU-C TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK		OFF-PEAK	
Generation:				
Summer (all usage)	$0.19776		$0.13432	
Winter (all usage)	$0.14916		$0.12413	
Distribution:**				
Summer (all usage)	$0.17029	(I)	$0.15029	(I)
Winter (all usage)	$0.11618	(I)	$0.11286	(I)

Conservation Incentive Adjustment (Baseline Usage)	($0.02216)	(I)
Conservation Incentive Adjustment (Over Baseline Usage)	$0.06635	(I)
Transmission* (all usage)	$0.05254	
Transmission Rate Adjustments* (all usage)	$0.00059	
Reliability Services* (all usage)	$0.00069	
Public Purpose Programs (all usage)	$0.02578	
Nuclear Decommissioning (all usage)	$0.00135	
Competition Transition Charges (all usage)	$0.00030	
Energy Cost Recovery Amount (all usage)	($0.00071)	
Wildfire Fund Charge (all usage)	$0.00530	
New System Generation Charge (all usage)**	$0.00346	
Wildfire Hardening Charge (all usage)	$0.00254	
Recovery Bond Charge (all usage)	$0.00528	(R)
Recovery Bond Credit (all usage)	($0.00528)	(I)
Bundled Power Charge Indifference Adjustment (all usage)***	$0.01309	

* Transmission, Transmission Rate Adjustments and Reliability Service charges are combined for presentation on customer bills.
** Distribution and New System Generation Charges are combined for presentation on customer bills.
*** Direct Access, Community Choice Aggregation and Transitional Bundled Service Customers pay the applicable Vintaged Power Charge Indifference Adjustment. Generation and Bundled PCIA are combined for presentation on bundled customer bills.

(Continued)

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ELECTRIC SCHEDULE E-ELEC Sheet 2
RESIDENTIAL TIME-OF-USE (ELECTRIC HOME)
SERVICE FOR CUSTOMERS WITH QUALIFYING ELECTRIC TECHNOLOGIES

RATES:(Cont'd.)

TOTAL BUNDLED RATES

Base Services Charge ($ per meter per day)	$0.49281						
Total Energy Rates ($ per kWh)	PEAK		PART-PEAK		OFF-PEAK		
Summer Usage	$0.56589	(I)	$0.40401	(I)	$0.34733	(I)	
Winter Usage	$0.33438	(I)	$0.31229	(I)	$0.29843	(I)	
California Climate Credit (per household, per semi-annual payment occurring in the March† and October bill cycles)	($38.39)						

Total bundled service charges shown on a customer's bills are unbundled according to the component rates shown below.

UNBUNDLING OF TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK		PART-PEAK		OFF-PEAK	
Generation:						
Summer Usage	$0.28164		$0.18253		$0.13743	
Winter Usage	$0.11951		$0.09954		$0.08619	
Distribution:**						
Summer Usage	$0.17932	(I)	$0.11655	(I)	$0.10497	(I)
Winter Usage	$0.10994	(I)	$0.10782	(I)	$0.10731	(I)
Transmission* (all usage)	$0.05254		$0.05254		$0.05254	
Transmission Rate Adjustments* (all usage)	$0.00059		$0.00059		$0.00059	
Reliability Services* (all usage)	$0.00069		$0.00069		$0.00069	
Public Purpose Programs (all usage)	$0.02578		$0.02578		$0.02578	
Nuclear Decommissioning (all usage)	$0.00135		$0.00135		$0.00135	
Competition Transition Charges (all usage)	$0.00030		$0.00030		$0.00030	
Energy Cost Recovery Amount (all usage)	($0.00071)		($0.00071)		($0.00071)	
Wildfire Fund Charge (all usage)	$0.00530		$0.00530		$0.00530	
New System Generation Charge (all usage)**	$0.00346		$0.00346		$0.00346	
Wildfire Hardening Charge (all usage)	$0.00254		$0.00254		$0.00254	
Recovery Bond Charge (all usage)	$0.00528	(R)	$0.00528	(R)	$0.00528	(R)
Recovery Bond Credit (all usage)	($0.00528)	(I)	($0.00528)	(I)	($0.00528)	(I)
Bundled Power Charge Indifference Adjustment (all usage)***	$0.01309		$0.01309		$0.01309	

* Transmission, Transmission Rate Adjustments and Reliability Service charges are combined for presentation on customer bills.
** Distribution and New System Generation Charges are combined for presentation on customer bills.
*** Direct Access, Community Choice Aggregation and Transitional Bundled Service Customers pay the applicable Vintaged Power Charge Indifference Adjustment. Generation and Bundled PCIA are combined for presentation on bundled customer bills.
† Pursuant to D.23-02-014, disbursement of the April 2023 residential Climate Credit shall begin by March 1, 2023.

(Continued)

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U 39 San Francisco, California

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ELECTRIC SCHEDULE E-ELEC Sheet 3 (N)
RESIDENTIAL TIME-OF-USE (ELECTRIC HOME) (N)
SERVICE FOR CUSTOMERS WITH QUALIFYING ELECTRIC TECHNOLOGIES

SPECIAL CONDITIONS:

1. TIME PERIODS: Times of the year and times of the day are defined as follows: (N)

   All Year:

   Peak: 4:00 p.m. to 9:00 p.m. every day including weekends and holidays.

   Partial-Peak: 3:00 p.m. to 4:00 p.m. and 9:00 p.m. to 12:00 a.m. every day including weekends and holidays.

   Off-Peak: All other hours.

2. SEASONAL CHANGES: The summer season is June 1 through September 30 and the winter season is October 1 through May 31. When billing includes use in both the summer and winter periods, charges will be prorated based upon the number of days in each period.

3. ADDITIONAL METERS: If a residential dwelling unit is served by more than one electric meter, the customer must designate which meter is the primary meter and which is (are) the additional meter(s).

4. BILLING: A customer's bill is calculated based on the option applicable to the customer.

   Bundled Service Customers receive generation and delivery services solely from PG&E. The customer's bill is based on the Unbundling of Total Rates set forth above.

   Transitional Bundled Service (TBS) Customers take TBS as prescribed in Rules 22.1 and 23.1, or take PG&E bundled service prior to the end of the six (6) month advance notice period required to elect PG&E bundled service as prescribed in Rules 22.1 and 23.1. TBS customers shall pay all charges shown in the Unbundling of Total Rates except for the Bundled Power Charge Indifference Adjustment and the generation charge. TBS customers shall also pay for their applicable Vintaged Power Charge Indifference Adjustment provided in the table below, and the short-term commodity prices as set forth in Schedule TBCC. (N)

(Continued)

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Pacific Gas and Electric Company
U 39 San Francisco, California

Revised Cal. P.U.C. Sheet No. 54734-E
Cancelling Revised Cal. P.U.C. Sheet No. 53424-E

ELECTRIC SCHEDULE D-CARE Sheet 1
LINE-ITEM DISCOUNT FOR CALIFORNIA ALTERNATE RATES FOR ENERGY (CARE) CUSTOMERS

APPLICABILITY: This schedule is applicable to single-phase and polyphase residential service in single-family dwellings and in flats and apartments separately metered by PG&E and domestic submetered tenants residing in multifamily accommodations, mobilehome parks and to qualifying recreational vehicle parks and marinas and to farm service on the premises operated by the person whose residence is supplied through the same meter, where the applicant qualifies for California Alternate Rates for Energy (CARE) under the eligibility and certification criteria set forth in Electric Rule 19.1. CARE service is available on Schedules E-1, E-6, E-TOU-B, E-TOU-C, E-TOU-D, EV2, E-ELEC, EM, ES, ESR, ET and EM-TOU. (T)

TERRITORY: This rate schedule applies everywhere PG&E provides electric service.

RATES: Customers taking service on this rate schedule whose otherwise applicable rate schedule has no Delivery Minimum Bill Amount (Schedule E-ELEC) will receive a CARE percentage discount of 35.000% on their total bundled charges (except for the California Climate Credit, which will not be discounted). Customers taking service on this rate schedule whose otherwise applicable rate schedule has a Delivery Minimum Bill Amount (all other schedules) will receive a CARE percentage discount ("A" or "C" below) on their total bundled charges on their otherwise applicable rate schedule (except for the California Climate Credit, which will not be discounted) and also will receive a percentage discount ("B" or "D" below) on the delivery minimum bill amount, if applicable. The CARE discount will be calculated for direct access and community choice aggregation customers based on the total charges as if they were subject to bundled service rates. Discounts will be applied as a residual reduction to distribution charges, after D-CARE customers are exempted from the Wildfire Fund Charge, Recovery Bond Charge, Recovery Bond Credit, and the CARE surcharge portion of the public purpose program charge used to fund the CARE discount. These conditions also apply to master-metered customers and to qualified sub-metered tenants where the master-meter customer is jointly served under PG&E's Rate Schedule D-CARE and either Schedule EM, ES, ESR, ET, or EM-TOU. (N) | | (N) (T) | (T) (T)

For master-metered customers where one or more of the submetered tenants qualifies for CARE rates under the eligibility and certification criteria set forth in Rule 19.1, 19.2, or 19.3, the CARE discount is equal to a percentage ("C" below) of the total bundled charges, multiplied by the number of CARE units divided by the total number of units. In addition, master-metered customers eligible for D-CARE will receive a percentage discount ("D" below) on the delivery minimum bill amount, if applicable.

It is the responsibility of the master-metered customer to advise PG&E within 15 days following any change in the number of dwelling units and/or any decrease in the number of qualifying CARE applicants that results when such applicants move out of their submetered or non-submetered dwelling unit, or submetered permanent-residence RV or permanent-residence boat. (L) | (L)

(Continued)

Pacific Gas and Electric Company
U 39 San Francisco, California

Revised Cal. P.U.C. Sheet No. 56208-E
Cancelling Revised Cal. P.U.C. Sheet No. 56020-E

ELECTRIC SCHEDULE D-CARE Sheet 2
LINE-ITEM DISCOUNT FOR CALIFORNIA ALTERNATE RATES FOR ENERGY (CARE) CUSTOMERS

RATES: (Cont'd)

A.	D-CARE Discount:	34.965	% (Percent)	(I)
B.	Delivery Minimum Bill Discount:	50.000	% (Percent)	
C.	Master-Meter D-CARE Discount:	34.965	% (Percent)	(I)
D.	Master-Meter Delivery Minimum Bill Discount:	50.000	% (Percent)	

SPECIAL CONDITIONS:

1. OTHERWISE APPLICABLE SCHEDULE: The Special Conditions of the Customer's otherwise applicable rate schedule will apply to this schedule.

2. ELIGIBILITY: To be eligible to receive D-CARE the applicant must qualify under the criteria set forth in PG&E's Electric Rules 19.1, 19.2, and 19.3 and meet the certification requirements thereof to the satisfaction of PG&E. Qualifying Direct Access, Community Choice Aggregation Service, and Transitional Bundled Service customers are also eligible to take service on Schedule D-CARE. Applicants may qualify for D-CARE at their primary residence only. Customers or sub-metered tenants participating in the Family Electric Rate Assistance (FERA) program cannot concurrently participate in the CARE program.

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Decision

Issued by
Meredith Allen
Vice President, Regulatory Affairs

Submitted June 23, 2023
Effective July 1, 2023
Resolution

6.2.2 Southern California Edison

The following pages provide details on the SCE electricity tariffs applied in this study. Table 22 describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of $ 0.06030/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between December 2022 and November 2023

Table 22: SCE Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ06	6
CZ08	8
CZ09	9
CZ10	10
CZ14	14
CZ15	15

Summer Daily Allocations (June through September)

Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	17.2	17.9
6	11.4	8.8
8	12.6	9.8
9	16.5	12.4
10	18.9	15.8
13	22.0	24.6
14	18.7	18.3
15	46.4	24.1
16	14.4	13.5

Winter Daily Allocations (October through May)

Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	18.7	29.1
6	11.3	13.0
8	10.6	12.7
9	12.3	14.3
10	12.5	17.0
13	12.6	24.3
14	12.0	21.3
15	9.9	18.2
16	12.6	23.1

Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 12 (T)

SPECIAL CONDITIONS

1. Applicable rate time periods are defined as follows:

Option 4-9 PM, Option 4-9 PM-CPP, Option PRIME, Option PRIME-CPP : (T)

TOU Period	Weekdays		Weekends and Holidays	
	Summer	Winter	Summer	Winter
On-Peak	4 p.m. - 9 p.m.	N/A	N/A	N/A
Mid-Peak	N/A	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.
Off-Peak	All other hours	9 p.m. - 8 a.m.	All other hours	9 p.m. - 8 a.m.
Super-Off-Peak	N/A	8 a.m. - 4 p.m.	N/A	8 a.m. - 4 p.m.
CPP Event Period	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	N/A	N/A

Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 85111-E
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Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 2

RATES

Customers receiving service under this Schedule will be charged the applicable rates under Option 4-9 PM, Option 4-9 PM-CPP, Option 5-8 PM, Option 5-8 PM-CPP, Option PRIME, Option PRIME-CPP Option A, Option A-CPP, Option B, or Option B-CPP, as listed below. CPP Event Charges will apply to all energy usage during CPP Event Energy Charge periods and CPP Non-Event Energy Credits will apply as a reduction on CPP Non-Event Energy Credit Periods during Summer Season days, 4:00 p.m. to 9:00 p.m., as described in Special Conditions 1 and 3, below:

	Delivery Service Total[1]	Generation[2] UG***	Generation[2] DWREC[3]
Option 4-9 PM / Option 4-9 PM-CPP			
Energy Charge - $/kWh			
Summer Season - On-Peak	0.28829 (R)	0.28543 (I)	0.00000
Mid-Peak	0.28829 (R)	0.17707 (I)	0.00000
Off-Peak	0.24482 (R)	0.11382 (I)	0.00000
Winter Season - Mid-Peak	0.28829 (R)	0.21752 (I)	0.00000
Off-Peak	0.24482 (R)	0.13851 (I)	0.00000
Super-Off-Peak	0.22919 (R)	0.11890 (I)	0.00000
Baseline Credit**** - $/kWh	(0.09759) (I)	0.00000	
Fixed Recovery Charge - $/kWh	0.00090 (R)		
Basic Charge - $/day			
Single-Family Residence	0.031		
Multi-Family Residence	0.024		
Minimum Charge** - $/day			
Single Family Residence	0.346		
Multi-Family Residence	0.346		
Minimum Charge (Medical Baseline)** - $/day			
Single Family Residence	0.173		
Multi-Family Residence	0.173		
California Climate Credit[10]	(71.00) (I)		
California Alternate Rates for Energy Discount - %	100.00*		
Family Electric Rate Assistance Discou	100.00		
Option 4-9 PM-CPP			
CPP Event Energy Charge - $/kWh		0.80000	
Summer CPP Non-Event Credit On-Peak Energy Credit - $/kWh		(0.15170)	
Maximum Available Credit - $/kWh***** Summer Season		(0.67183) (R)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
** The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.
*** The ongoing Competition Transition Charge CTC of ($0.00003) per kWh is recovered in the UG component of Generation. (I)
**** The Baseline Credit applies up to 100% of the Baseline Allocation, regardless of Time-of-Use time period. Additional Baseline Allocations apply for Customers with Heat Pump Water Heaters served under this Option. The Baseline Allocations are set forth in Preliminary Statement, Part H.
*****The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs.
1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.
2 Generation = The Gen rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.
3 DWREC = Department of Water Resources (DWR) Energy Credit – For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

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Southern California Edison
Rosemead, California (U 338-E)

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Cancelling Revised Cal. PUC Sheet No. 85624-E

Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 6

RATES (Continued)

Option PRIME / Option PRIME-CPP	Delivery Service Total[1]	Generation[2] UG**	Generation[2] DWREC[3]
Energy Charge - $/kWh/Meter/Day			
Summer Season			
On-Peak	0.22789 (I)	0.42769 (I)	0.00000
Mid-Peak	0.22789 (I)	0.15221 (I)	0.00000
Off-Peak	0.15191 (I)	0.10162 (I)	0.00000
Winter Season			
Mid-Peak	0.23353 (I)	0.36028 (I)	0.00000
Off-Peak	0.14530 (I)	0.08630 (I)	0.00000
Super-Off-Peak	0.14530 (I)	0.08630 (I)	0.00000
Fixed Recovery Charge - $/kWh	0.00260 (I)		
Basic Charge - $/Meter/Day	0.427 (I)		
EV Meter Credit (Separately Metered E	(0.323) (N)		
EV Submeter Credit - $/Meter/Day	(0.111) (R)		
California Climate Credit[10]	(71.00)		
California Alternate Rates for Energy Discount - %	100.00*		
Family Electric Rate Assistance Discou	100.00		
Medical Line Item Discount - %	100.000		
Option PRIME-CPP			
CPP Event Energy Charge - $/kWh		0.80000	
Summer CPP Non-Event Credit On-Peak Energy Credit - $/kWh		(0.15170)	
Maximum Available Credit - $/kWh**** Summer Season		(0.71812) (R)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
** The ongoing Competition Transition Charge (CTC) of ($0.00003) per kWh is recovered in the UG component of Generation.
**** The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs.
1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.
2 Generation = The Gen rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.
3 DWREC = Department of Water Resources (DWR) Energy Credit – For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

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6H9

Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 85618-E
Cancelling Revised Cal. PUC Sheet No. 85109-E

Schedule D-CARE Sheet 1
CALIFORNIA ALTERNATE RATES FOR ENERGY
DOMESTIC SERVICE

APPLICABILITY

Applicable to domestic service to CARE households residing in a permanent Single-Family Accommodation or Multifamily Accommodation where the customer meets all the Special Conditions of this Schedule. Customers enrolled in the CARE program are not eligible for the Family Electric Rate Assistance (FERA) program.

Pursuant to Special Condition 12 herein, customers receiving service under this Schedule are eligible to receive the California Climate Credit as shown in the Rates section below.

TERRITORY

Within the entire territory served.

RATES

The applicable charges set forth in Schedule D shall apply to Customers served under this Schedule.

CARE Discount:

A 29.8 percent discount is applied to a CARE Customer's bill prior to the application of the Public Utilities Commission Reimbursement Fee (PUCRF) and any applicable user fees, taxes, and late payment charges. CARE Customers are required to pay the PUCRF and any applicable user fees, taxes, and late payment charges in full. In addition, CARE Customers are exempt from paying the CARE Surcharge of $0.00888 per kWh and the Wildfire Fund Non-Bypassable Charge of $0.00530 per kWh. (R)
The 29.8 percent discount, in addition to these exemptions result in an average effective CARE Discount of 32.5 percent.

(Continued)

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Decision 23-01-002
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Vice President

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Resolution

6.2.3 Southern California Gas

Following are the SoCalGas natural gas tariffs applied in this study. Table 23 describes the baseline territories that were assumed for each climate zone.

Table 23. SoCalGas Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ05	2
CZ06	1
CZ08	1
CZ09	1
CZ10	1
CZ14	2
CZ15	1

The SoCalGas monthly gas rate in $/therm was applied on a monthly basis according to the rates shown in Table 24. These rates are based on applying a normalization curve to the November 2023 tariff based on ten years of historical gas data. Long-term historical natural gas rate data was only available for SoCalGas' procurement charges.[27] The baseline and excess transmission charges were found to be consistent over the course of a year and applied for the entire year based on 2023 rates. CARE rates reflect the 20 percent discount per the GR tariff.

Table 24. SoCalGas Monthly Gas Rate ($/therm)

Month	Procurement Charge	Transportation Charge		Total Charge	
		Baseline	Excess	Baseline	Excess
January	$0.72	$0.86	$1.31	$1.92	$2.36
February	$0.50	$0.86	$1.31	$1.57	$2.02
March	$0.44	$0.86	$1.31	$1.48	$1.93
April	$0.39	$0.86	$1.31	$1.39	$1.84
May	$0.41	$0.86	$1.31	$1.43	$1.87
June	$0.46	$0.86	$1.31	$1.49	$1.93
July	$0.47	$0.86	$1.31	$1.51	$1.96
August	$0.51	$0.86	$1.31	$1.58	$2.03
September	$0.46	$0.86	$1.31	$1.52	$1.96
October	$0.45	$0.86	$1.31	$1.48	$1.92
November	$0.48	$0.86	$1.31	$1.54	$1.99
December	$0.57	$0.86	$1.31	$1.63	$2.08

Southern California Gas Company
Residential Rates
Nov-23

Customer Type / Rate Schedule	Commodity Charge	Rate Type	Procurement Charge ¢/therm	Transportation Charge ¢/therm	New Rate Effective 11/1/2023	New Rate Effective 10/1/2023	Absolute Rate Change	% Change
Residential Individually Metered								
Schedule No. GR	GR	Baseline	67.806	86.490	154.296	125.096	29.200	23.3%
Res. Service	GR	Non Baseline	67.806	131.037	198.843	169.726	29.117	17.2%
	GT-R	Baseline	00.000	86.490	86.490	87.038	-00.548	-0.6%
	GT-R	Non Baseline	00.000	131.037	131.037	131.668	-00.631	-0.5%

[27] The SoCalGas procurement and transmission charges were obtained from the following site: https://www.socalgas.com/for-your-business/energy-market-services/gas-prices RES2023.xlsx (live.com)

6.2.4 San Diego Gas & Electric

Following are the SDG&E electricity and natural gas tariffs applied in this study. Table 25 describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of $0.04542/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between December 2022 and November 2023.

Table 25. SDG&E Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
CZ07	Coastal
CZ10	Inland
CZ14	Mountain

The SDG&E monthly gas rate in $/therm was applied on a monthly basis according to the rates shown in Table 26. These rates are based on applying a normalization curve to the November 2023 tariff based on ten years of historical gas data. CARE rates reflect the 20 percent discount per the G-CARE tariff.

Table 26. SDG&E Monthly Gas Rate ($/therm)

Month	Total Charge	
	Baseline	Excess
January	$2.34	$2.63
February	$2.28	$2.57
March	$2.21	$2.51
April	$2.14	$2.45
May	$2.18	$2.48
June	$2.23	$2.55
July	$2.26	$2.57
August	$2.32	$2.62
September	$2.26	$2.59
October	$2.21	$2.55
November	$2.24	$2.57
December	$2.38	$2.70

Baseline Usage: The following quantities of gas used in individually metered residences are to be billed at the baseline rates:

All Customers:	Daily Therm Allowance
Summer (May to Oct)	0.359
Winter On-Peak (Dec, Jan & Feb)	1.233
Winter Off-Peak (Nov, Mar, & Apr)	0.692

SDGE
San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 37022-E
Canceling Revised Cal. P.U.C. Sheet No. 36337-E

SCHEDULE TOU-DR1

Sheet 2

RESIDENTIAL TIME-OF-USE

RATES

Total Rates:

Description – TOU DR1	UDC Total Rate		DWR BC + WF-NBC		EECC Rate + DWR Credit		Total Rate	
Summer:								
On-Peak	0.25752	R	0.00530	I	0.57043	I	0.83325	I
Off-Peak	0.25752	R	0.00530	I	0.25697	I	0.51979	I
Super Off-Peak	0.25752	R	0.00530	I	0.09233	I	0.35515	I
Winter:								
On-Peak	0.43809	I	0.00530	I	0.19307	I	0.63646	I
Off-Peak	0.43809	I	0.00530	I	0.10855	I	0.55194	I
Super Off-Peak	0.43809	I	0.00530	I	0.08402	I	0.52741	I
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.11724)	R					(0.11724)	R
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.11724)	R					(0.11724)	R
Minimum Bill ($/day)	0.380	I					0.380	I

Description – TOU DR1-CARE	UDC Total Rate		DWR BC + WF-NBC		EECC Rate + DWR Credit		Total Rate		Total Effective Care Rate	
Summer – CARE Rates:										
On-Peak	0.25682	R	0.00000		0.57043	I	0.82725	I	0.55366	I
Off-Peak	0.25682	R	0.00000		0.25697	I	0.51379	I	0.33965	I
Super Off-Peak	0.25682	R	0.00000		0.09233	I	0.34915	I	0.22725	I
Winter – CARE Rates:										
On-Peak	0.43739	I	0.00000		0.19307	I	0.63046	I	0.41930	I
Off-Peak	0.43739	I	0.00000		0.10855	I	0.54594	I	0.36160	I
Super Off-Peak	0.43739	I	0.00000		0.08402	I	0.52141	I	0.34485	I
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.11724)	R					(0.11724)	R	(0.08004)	R
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.11724)	R					(0.11724)	R	(0.08004)	R
Minimum Bill ($/day)	0.190	I					0.190	I	0.190	I

Note:
(1) Total Rates consist of UDC, Schedule DWR-BC (Department of Water Resources Bond Charge), Schedule WF-NBC (CA Wildfire Fund charge) and Schedule EECC (Electric Energy Commodity Cost) rates, with the EECC rates reflecting a DWR Credit. EECC rates are applicable to bundled customers only. See Special Condition 16 for PCIA (Power Charge Indifference Adjustment) recovery.
(2) Total Rates presented are for customers that receive commodity supply and delivery service from Utility.
(3) DWR-BC and WF-NBC charges do not apply to CARE customers.
(4) As identified in the rates tables, customer bills will also include line-item summer and winter credits for usage up to 130% of baseline to provide the rate capping benefits adopted by Assembly Bill 1X and Senate Bill 695.
(5) WF-NBC rate is 0.00530 + DWR-BC Bond Charge is 0.00000 .

R, I

(Continued)

2C8
Issued by
Dan Skopec
Senior Vice President
Regulatory Affairs

Advice Ltr. No. 4129-E
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Time Periods

All time periods listed are applicable to local time. The definition of time will be based upon the date service is rendered.

TOU Periods – Weekdays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	6:00 a.m. – 4:00 p.m.; 9:00 p.m. - midnight	6:00 a.m. – 4:00 p.m. Excluding 10:00 a.m. – 2:00 p.m. in March and April; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m. 10:00 a.m. – 2:00 p.m. in March and April
TOU Period – Weekends and Holidays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

Seasons: Summer June 1 – October 31
Winter November 1 – May 31

15. Baseline Usage: The following quantities of electricity are used to calculate the baseline adjustment credit.

	Baseline Allowance For Climatic Zones*			
	Coastal	Inland	Mountain	Desert
Basic Allowance				
Summer (June 1 to October 31)	9.0	10.4	13.6	15.9
Winter (November 1 to May 31)	9.2	9.6	12.9	10.9
All Electric**				
Summer (June 1 to October 31)	6.0	8.7	15,2	17.0
Winter (November 1 to May 31)	8.8	12.2	22.1	17.1

* Climatic Zones are shown on the Territory Served, Map No. 1.
** All Electric allowances are available upon application to those customers who have permanently installed space heating or who have electric water heating and receive no energy from another source.

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 37217-E
Canceling Revised Cal. P.U.C. Sheet No. 37016-E

SCHEDULE EV-TOU-5

Sheet 1

COST-BASED DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES

APPLICABILITY

Service under this schedule is specifically limited to customers who require service for charging of a currently registered Motor Vehicle, as defined by the California Motor Vehicle Code, which is: 1) a battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV) recharged via a recharging outlet at the customer's premises; or 2) a natural gas vehicle (NGV) refueled via a home refueling appliance (HRA) at the customer's premises. This schedule is not available to customers with a conventional charge sustaining (battery recharged solely from the vehicle's on-board generator) hybrid electric vehicle (HEV).

Residential customers taking service on Schedule NBT, who are required to utilize EV-TOU-5 as their otherwise applicable schedule (OAS) for electric service, do not require a qualifying motor vehicle, as described above to participate on Schedule EV-TOU-5. N N N

Customers on this schedule may also qualify for a semi-annual California Climate Credit $(60.70) per Schedule GHG-ARR.

TERRITORY

Within the entire territory served by the utility.

RATES

Total Rates:

Description – EV-TOU-5 Rates	UDC Total Rate	DWR BC + WF-NBC	EECC Rate + DWR Credit	Total Rate
Basic Service Fee	16.00			16.00
Summer				
On-Peak	0.28032 I	0.00530 I	0.53067 I	0.81629 I
Off-Peak	0.28032 I	0.00530 I	0.19567 I	0.48129 I
Super Off-Peak	0.05588 I	0.00530 I	0.09233 I	0.15351 I
Winter				
On-Peak	0.28032 I	0.00530 I	0.22587 I	0.51149 I
Off-Peak	0.28032 I	0.00530 I	0.16213 I	0.44775 I
Super Off-Peak	0.05588 I	0.00530 I	0.08402 I	0.14520 I

(Continued)

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San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 37019-E
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SCHEDULE EV-TOU-5

Sheet 4

COST-BASED DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES

Notes: Transmission Energy charges include the Transmission Revenue Balancing Account Adjustment (TRBAA) of $(0.00242) per kWh and the Transmission Access Charge Balancing Account Adjustment (TACBAA) of $(0.01631) per kWh. PPP Energy charges includes Low Income PPP rate (LI-PPP) $0.01669/kWh, Non-low Income PPP rate (Non-LI-PPP) $0.00333/kWh (pursuant to PU Code Section 399.8, the Non-LI-PPP rate may not exceed January 1, 2000 levels), Procurement Energy Efficiency Surcharge Rate of $0.00422 /kWh, California Solar Initiative rate (CSI) of $0.00000/kWh and Self-Generation Incentive Program rate (SGIP) $0.00122/kWh. The basic service fee of $16 per month is applied to a customer's bill and a 50% discount is applied for CARE, Medical Baseline, or Family Electric Rate Assistance Program (FERA) customers resulting in their basic service fees to be $8 per month. R, R I R I I

Rate Components
The Utility Distribution Company Total Rates (UDC Total) shown above are comprised of the following components (if applicable): (1) Transmission (Trans) Charges, (2) Distribution (Distr) Charges, (3) Public Purpose Program (PPP) Charges, (4) Nuclear Decommissioning (ND) Charge, (5) Ongoing Competition Transition Charges (CTC), (6) Local Generation Charge (LGC), (7) Reliability Services (RS), and (8) the Total Rate Adjustment Component (TRAC).

Certain Direct Access customers are exempt from the TRAC, as defined in Rule 1 – Definitions.

Franchise Fee Differential
A Franchise Fee Differential of 5.78% will be applied to the monthly billings calculated under this schedule for all customers within the corporate limits of the City of San Diego. Such Franchise Fee Differential shall be so indicated and added as a separate item to bills rendered to such customers.

Time Periods:

All time periods listed are applicable to actual "clock" time)

TOU Period – Weekdays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	6:00 a.m. – 4:00 p.m.; 9:00 p.m. – midnight	6:00 a.m. – 4:00 p.m. Excluding 10:00 a.m.–2:00 p.m.in March and April; 9:00 p.m. - midnight
Super-Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m. 10:00 a.m. – 2:00 p.m. in March and April

TOU Period – Weekends and Holidays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	2:00 p.m. – 4:00 p.m.; 9:00 p.m. – midnight	2:00 p.m. – 4:00 p.m. 9:00 p.m. - midnight
Super-Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

Seasons:

Summer June 1 – October 31
Winter November 1 – May 31

(Continued)

4C8
Issued by
Dan Skopec
Senior Vice President
Regulatory Affairs

Submitted Dec 30, 2022
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Resolution No. E-5217

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Decision No.

SDGE
San Diego Gas & Electric Company
San Diego, California

Original Cal. P.U.C. Sheet No. 37195-E
Canceling _____ Cal. P.U.C. Sheet No. _____

SCHEDULE TOU-ELEC

Sheet 1

N
N

DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES, ENERGY STORAGE, OR ELECTRIC HEAT PUMPS

APPLICABILITY N

Service under this schedule is available on a voluntary basis for all residential customers who meet one or more of the following criteria: 1) require service for charging of a currently registered Motor Vehicle, as defined by the California Motor Vehicle Code, which is: a) a battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV) recharged via a recharging outlet at the customer's premises; or b) a natural gas vehicle (NGV) refueled via a home refueling appliance (HRA) at the customer's premises; 2) have a behind-the-meter energy storage device that is interconnected through Electric Rule 21; or 3) have an electric heat pump for water heating or climate control. This schedule is not available to customers with a conventional charge sustaining (battery recharged solely from the vehicle's on-board generator) hybrid electric vehicle (HEV).

This schedule is also available to customers who meet the above criteria as well as qualify for the California Alternate Rates for Energy (CARE) Program as outlined in Schedule E-CARE, and/or Medical Baseline as outlined in Special Condition (SC) 5. The rates for CARE customers and/or Medical Baseline are identified in the rate tables below as TOU-ELEC-CARE and TOU-ELEC-MB rates, respectively.

There is a cap of 10,000 customers who may take service on this rate, as defined in SC 10.

Pursuant to D.22-11-022, customers that opt-in to schedule TOU-ELEC within its first year of being offered have the option to return to their previous rate schedule prior to the 12-month requirement. See SC4 Terms of Service for all requirements.

Customers on this schedule may also qualify for a semi-annual California Climate Credit $(60.70) per Schedule GHG-ARR.

TERRITORY

Within the entire territory served by the utility.

RATES

Total Rates:

Description – TOU-ELEC Rates	UDC Total Rate	DWR BC + WF-NBC	EECC Rate	Total Rate
Monthly Service Fee	16.00			16.00
Summer				
On-Peak	0.22228	0.00530	0.51568	0.74326
Off-Peak	0.22228	0.00530	0.14644	0.37402
Super Off-Peak	0.22228	0.00530	0.09785	0.32543
Winter				
On-Peak	0.22228	0.00530	0.27460	0.50218
Off-Peak	0.22228	0.00530	0.13323	0.36081
Super Off-Peak	0.22228	0.00530	0.08905	0.31663

N

(Continued)

1H6 Issued by Submitted Jan 31, 2023
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San Diego Gas & Electric Company
San Diego, California

Original Cal. P.U.C. Sheet No. 37196-E
Canceling _____ Cal. P.U.C. Sheet No. _____

SCHEDULE TOU-ELEC

Sheet 2

DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES, ENERGY STORAGE, OR ELECTRIC HEAT PUMPS

RATES (Continued)

Description – TOU-ELEC CARE Rates	UDC Total Rate	DWR BC + WF-NBC	EECC Rate	Total Rate	Total Effective CARE Rate
Monthly Service Fee	16.00			16.00	16.00
Summer – CARE Rates:					
On-Peak	0.22158	0.00000	0.51568	0.73726	0.49222
Off-Peak	0.22158	0.00000	0.14644	0.36802	0.24013
Super Off-Peak	0.22158	0.00000	0.09785	0.31943	0.20696
Winter – CARE Rates:					
On-Peak	0.22158	0.00000	0.27460	0.49618	0.32763
Off-Peak	0.22158	0.00000	0.13323	0.35481	0.23111
Super Off-Peak	0.22158	0.00000	0.08905	0.31063	0.20095

Description – TOU-ELEC MB Rates	UDC Total Rate	DWR BC + WF-NBC	EECC Rate	Total Rate	Total Effective MB Rate
Monthly Service Fee	16.00			16.00	16.00
Summer – MB Rates:					
On-Peak	0.22228	0.00000	0.51568	0.73796	0.59037
Off-Peak	0.22228	0.00000	0.14644	0.36872	0.29498
Super Off-Peak	0.22228	0.00000	0.09785	0.32013	0.25610
Winter – MB Rates:					
On-Peak	0.22228	0.00000	0.27460	0.49688	0.39750
Off-Peak	0.22228	0.00000	0.13323	0.35551	0.28441
Super Off-Peak	0.22228	0.00000	0.08905	0.31133	0.24906

Note:
(1) Total Rates consist of UDC, Schedule DWR-BC (Department of Water Resources Bond Charge), Schedule WF-NBC (CA Wildfire Fund charge) and Schedule EECC (Electric Energy Commodity Cost) rates. EECC rates are applicable to bundled customers only. See Special Condition 9 for PCIA (Power Charge Indifference Adjustment) recovery.
(2) Total Rates presented are for customers that receive commodity supply and delivery service from Utility. Differences in total rates paid by Direct Access (DA) and Community Choice Aggregation (CCA) customers are identified in Schedule DA-CRS and CCA-CRS, respectively.
(3) DWR-BC and WF-NBC charges do not apply to CARE or Medical Baseline customers.
(4) WF-NBC rate is 0.00530 + DWR-BC Bond Charge is 0.00000

2H5 Issued by Submitted Jan 31, 2023
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SDGE
San Diego Gas & Electric Company
San Diego, California

Original Cal. P.U.C. Sheet No. 37197-E
Canceling ____ Cal. P.U.C. Sheet No. ____

SCHEDULE TOU-ELEC

Sheet 3 N

N

DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES, ENERGY STORAGE, OR ELECTRIC HEAT PUMPS

RATES (CONTINUED) N

UDC Rates

Description – TOU-ELEC	Transm	Distr	PPP	ND	CTC	LGC	RS	TRAC	UDC Total
Monthly Service Fee ($/Mo)		16.00							16.00
Summer:									
On-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Super Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Winter:									
On-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Super Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228

Description – TOU-ELEC – CARE Rates	**Transm**	**Distr**	**PPP**	**ND**	**CTC**	**LGC**	**RS**	**TRAC**	**UDC Total**
Monthly Service Fee ($/Mo		16.00							16.00
Summer CARE Rates:									
On-Peak	0.07340	0.10726	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22158
Off-Peak	0.07340	0.10726	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22158
Super Off-Peak	0.07340	0.10726	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22158
Winter CARE Rates:									
On-Peak	0.07340	0.10726	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22158
Off-Peak	0.07340	0.10726	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22158
Super Off-Peak	0.07340	0.10726	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22158

Description – TOU-ELEC – MB Rates	**Transm**	**Distr**	**PPP**	**ND**	**CTC**	**LGC**	**RS**	**TRAC**	**UDC Total**
Monthly Service Fee ($/Mo))		16.00							16.00
Summer – MB Rates									
On-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Super Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Winter – MB Rates									
On-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228
Super Off-Peak	0.07340	0.10796	0.02546	0.00007	0.00153	0.01383	0.00003	0.00000	0.22228

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3H11 Issued by Submitted Jan 31, 2023
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San Diego Gas & Electric Company
San Diego, California

Original Cal. P.U.C. Sheet No. 37198-E
Canceling _____ Cal. P.U.C. Sheet No. _____

SCHEDULE TOU-ELEC

Sheet 4 N

DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH ELECTRIC VEHICLES, ENERGY STORAGE, OR ELECTRIC HEAT PUMPS N

Notes: Transmission Energy charges include the Transmission Revenue Balancing Account Adjustment (TRBAA) of $(0.00242) per kWh and the Transmission Access Charge Balancing Account Adjustment (TACBAA) of $(0.01631) per kWh. PPP Energy charges includes Low Income PPP rate (LI-PPP) $0.01669/kWh, Non-low Income PPP rate (Non-LI-PPP) $0.00333/kWh (pursuant to PU Code Section 399.8, the Non-LI-PPP rate may not exceed January 1, 2000 levels), Procurement Energy Efficiency Surcharge Rate of $0.00422 /kWh, California Solar Initiative rate (CSI) of $0.00000/kWh and Self-Generation Incentive Program rate (SGIP) $0.00122/kWh. N

Rate Components
The Utility Distribution Company Total Rates (UDC Total) shown above are comprised of the following components (if applicable): (1) Transmission (Trans) Charges, (2) Distribution (Distr) Charges, (3) Public Purpose Program (PPP) Charges, (4) Nuclear Decommissioning (ND) Charge, (5) Ongoing Competition Transition Charges (CTC), (6) Local Generation Charge (LGC), (7) Reliability Services (RS), and (8) the Total Rate Adjustment Component (TRAC).

Certain Direct Access customers are exempt from the TRAC, as defined in Rule 1 – Definitions.

Franchise Fee Differential
A Franchise Fee Differential of 5.78% will be applied to the monthly billings calculated under this schedule for all customers within the corporate limits of the City of San Diego. Such Franchise Fee Differential shall be so indicated and added as a separate item to bills rendered to such customers.

Time Periods:

All time periods listed are applicable to actual "clock" time)

TOU Period – Weekdays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	6:00 a.m. – 4:00 p.m.; 9:00 p.m. – midnight	6:00 a.m. – 4:00 p.m. Excluding 10:00 a.m.–2:00 p.m.in March and April; 9:00 p.m. - midnight
Super-Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m. 10:00 a.m. – 2:00 p.m. in March and April

TOU Period – Weekends and Holidays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	2:00 p.m. – 4:00 p.m.; 9:00 p.m. – midnight	2:00 p.m. – 4:00 p.m. 9:00 p.m. - midnight
Super-Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

Seasons:

Summer June 1 – October 31
Winter November 1 – May 31 N

(Continued)

4H7 Issued by Submitted Jan 31, 2023
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Decision No. D.22-11-022 Resolution No. _____

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 35718-E
Canceling Revised Cal. P.U.C. Sheet No. 32576-E

SCHEDULE E-CARE

Sheet 1

CALIFORNIA ALTERNATE RATES FOR ENERGY

APPLICABILITY

This schedule provides a California Alternate Rates for Energy (CARE) discount to each of the following types of customers listed below that meet the requirements for CARE eligibility as defined in Rule 1, Definitions, and herein, and is taken in conjunction with the customer's otherwise applicable service schedule.

1) Customers residing in a permanent single-family accommodation, separately metered by the Utility.

2) Multi-family dwelling units and mobile home parks supplied through one meter on a single premises where the individual unit is submetered.

3) Non-profit group living facilities.

4) Agricultural employee housing facilities.

TERRITORY

Within the entire territory served by the Utility.

DISCOUNT

1) Residential CARE: Qualified residential CARE customers will receive a total effective discount according to the following:

	2015	2016	2017	2018	2019	2020 and beyond
Effective Discount	**40%**	**39%**	**38%**	**38%**	**36% R**	**35%**

Pursuant to Commission Decision (D.) 15-07-001, the average effective CARE discount for residential customers will decrease 1% each year until an average effective discount of 35% is reached in 2020.

The average effective CARE discount consists of: (a) exemptions from paying the CARE Surcharge, Department of Water Resources Bond Charge (DWR-BC), Vehicle-Grid Integration (VGI) costs, and California Solar Initiative (CSI); (b) a 50% minimum bill relative to Non-CARE; (c) the California Wildfire Fund Charge (WF-NBC) and (d) a separate line-item bill discount for all qualified residential CARE customers with the exclusion of CARE Medical Baseline customers taking service on tiered rates schedules. D.15-07-001 retained the rate subsidies in Non-CARE Medical Baseline tiered rates and thereby a separate line-item discount is provided for these CARE Medical Baseline customers T

(Continued)

1C5
Advice Ltr. No. 3928-E

Issued by
Dan Skopec
Vice President

Submitted Dec 30, 2021
Effective Jan 1, 2022

6.2.5 City of Palo Alto Utilities

Following are the CPAU electricity and natural gas tariffs applied in this study. The CPAU monthly gas rate in $/therm was applied on a monthly basis according to the rates shown in Table 27. These rates are based on applying a normalization curve to the October 2023 tariff based on seven years of historical gas data. The monthly service charge applied was $14.01 per month per the November 2023 G-1 tariff.

Table 27. CPAU Monthly Gas Rate ($/therm)

Month	G1 Volumetric Total Baseline	G1 Volumetric Total Excess
January	$1.83532	$3.35639
February	$1.38055	$2.59947
March	$1.32506	$2.47695
April	$1.29680	$2.44038
May	$1.29511	$2.43804
June	$1.32034	$2.45406
July	$1.35688	$2.61519
August	$1.40696	$2.67944
September	$1.42130	$2.70301
October	$1.42310	$2.48300
November	$1.46286	$2.45547
December	$1.62415	$2.62128

RESIDENTIAL ELECTRIC SERVICE

UTILITY RATE SCHEDULE E-1

A. APPLICABILITY:

This Rate Schedule applies to separately metered single-family residential dwellings receiving Electric Service from the City of Palo Alto Utilities.

B. TERRITORY:

This rate schedule applies everywhere the City of Palo Alto provides Electric Service.

C. UNBUNDLED RATES:

Per kilowatt-hour (kWh)	Commodity	Distribution	Public Benefits	Total
Tier 1 usage	$ 0.09999	$ 0.06954	$ 0.00568	$ 0.17521
Tier 2 usage Any usage over Tier 1	0.13873	0.10225	0.00568	0.24666
Minimum Bill ($/day)				0.4181

D. SPECIAL NOTES:

1. Calculation of Cost Components

The actual bill amount is calculated based on the applicable rates in Section C above and adjusted for any applicable discounts, surcharges and/or taxes. On a Customer's bill statement, the bill amount may be broken down into appropriate components as calculated under Section C.

2. Calculation of Usage Tiers

Tier 1 Electricity usage shall be calculated and billed based upon a level of 11 kWh per day, prorated by Meter reading days of Service. As an example, for a 30-day bill, the Tier 1 level would be 330 kWh. For further discussion of bill calculation and proration, refer to Rule and Regulation 11.

{End}

CITY OF PALO ALTO UTILITIES
Issued by the City Council

CITY OF PALO ALTO UTILITIES

Supersedes Sheet No E-1-1
dated 7-1-2022

Sheet No **E-1-1**
Effective 7-1-2023

6.2.6 Sacramento Municipal Utilities District (Electric Only)

Following are the SMUD electricity tariffs applied in this study. The rates effective January 2023 were used.

Residential Time-of-Day Service
Rate Schedule R-TOD

II. Firm Service Rates

A. Time-of-Day (5-8 p.m.) Rate

	Effective as of January 1, 2023	Effective as of January 1, 2024	Effective as of May 1, 2024	Effective as of January 1, 2025	Effective as of May 1, 2025
Time-of-Day (5-8 p.m.) Rate (RT02)					
Non-Summer Season (October - May)					
System Infrastructure Fixed Charge *per month per meter*	$23.50	$24.15	$24.80	$25.50	$26.20
Electricity Usage Charge					
Peak *$/kWh*	$0.1547	$0.1590	$0.1633	$0.1678	$0.1724
Off-Peak *$/kWh*	$0.1120	$0.1151	$0.1183	$0.1215	$0.1248
Summer Season (June - September)					
System Infrastructure Fixed Charge *per month per meter*	$23.50	$24.15	$24.80	$25.50	$26.20
Electricity Usage Charge					
Peak *$/kWh*	$0.3279	$0.3369	$0.3462	$0.3557	$0.3655
Mid-Peak *$/kWh*	$0.1864	$0.1914	$0.1967	$0.2021	$0.2077
Off-Peak *$/kWh*	$0.1350	$0.1387	$0.1425	$0.1464	$0.1505

B. Optional Critical Peak Pricing Rate

1. The CPP Rate base prices per time-of-day period are the same as the prices per time-of-day period for TOD (5-8 p.m.).
2. The CPP Rate provides a discount per kWh on the Mid-Peak and Off-Peak prices during summer months.
3. During CPP Events, customers will be charged for energy used at the applicable time-of-day period rate plus the CPP Rate Event Price per kWh as shown on www.smud.org.
4. During CPP Events, energy exported to the grid will be compensated at the CPP Rate Event Price per kWh as shown on www.smud.org.
5. The CPP Rate Event Price and discount will be updated annually at SMUD's discretion and posted on www.smud.org.

C. Plug-In Electric Vehicle Credit (rate categories RT02 and RTC1)

This credit is for residential customers who have a licensed passenger battery electric plug-in or plug-in hybrid electric vehicle.
Credit applies to all electricity usage charges from midnight to 6:00 a.m. daily.
Electric Vehicle Credit..... -$0.0150/kWh

III. Electricity Usage Surcharges

Refer to the following rate schedules for details on these surcharges.

A. Hydro Generation Adjustment (HGA). Refer to Rate Schedule HGA.

IV. Rate Option Menu

A. Energy Assistance Program Rate. Refer to Rate Schedule EAPR.
B. Medical Equipment Discount Program. Refer to Rate Schedule MED.
C. Joint Participation in Medical Equipment Discount and Energy Assistance Program Rate. Refer to Rate Schedule MED.

SACRAMENTO MUNICIPAL UTILITY DISTRICT Sheet No. **R-TOD-2**
Resolution No. 23-09-09 adopted September 21, 2023 Effective: **September 22, 2023**

A. Time-of-Day (5-8 p.m.) Rate (rate category RT02)

1. The TOD (5-8 p.m.) Rate is the standard rate for SMUD's residential customers. Eligible customers can elect the Fixed Rate under Rate Schedule R as an alternative rate.

2. The TOD (5-8 p.m.) Rate is an optional rate for customers who have an eligible renewable electrical generation facility under Rate Schedule NEM1 that was approved for installation by SMUD prior to January 1, 2018.

3. This rate has five kilowatt-hour (kWh) prices, depending on the time-of-day and season as shown below. Holidays are detailed in Section V. Conditions of Service.

Summer (Jun 1 - Sept 30)	**Peak**	Weekdays between 5:00 p.m. and 8:00 p.m.
	Mid-Peak	Weekdays between noon and midnight except during the Peak hours.
	Off-Peak	All other hours, including weekends and holidays[1].
Non-Summer (Oct 1 - May 31)	**Peak**	Weekdays between 5:00 p.m. and 8:00 p.m.
	Off-Peak	All other hours, including weekends and holidays[1].

[1] See Section V. Conditions of Service

6.2.7 Fuel Escalation Assumptions

The average annual escalation rates in Table 28 were used in this study. These are based on assumptions from the CPUC 2021 En Banc hearings on utility costs through 2030 (California Public Utilities Commission, 2021a). Escalation rates through the remainder of the 30-year evaluation period are based on the escalation rate assumptions within the 2022 TDV factors. No data was available to estimate electricity escalation rates for CPAU and SMUD, therefore electricity escalation rates for PG&E and statewide natural gas escalation rates were applied. Table 29 presents the average annual escalation rates used in the utility rate escalation sensitivity analysis shown in Section 3.2.4. Rates were applied for the same 30-year period and are based on the escalation rate assumptions within the 2025 LSC factors from 2027 through 2053.[28] These rates were developed for electricity use statewide (not utility-specific) and assume steep increases in gas rates in the latter half of the analysis period. Data was not available for the years 2024, 2025, and 2026 and so the CPUC En Banc assumptions were applied for those years using the average rate across the three IOUs for statewide electricity escalation.

Table 28: Real Utility Rate Escalation Rate Assumptions, CPUC En Banc and 2022 TDV Basis

	Statewide Natural Gas Residential Average Rate (%/year, real)	Electric Residential Average Rate (%/year, real)		
		PG&E	SCE	SDG&E
2024	4.6%	1.8%	1.6%	2.8%
2025	4.6%	1.8%	1.6%	2.8%
2026	4.6%	1.8%	1.6%	2.8%
2027	4.6%	1.8%	1.6%	2.8%
2028	4.6%	1.8%	1.6%	2.8%
2029	4.6%	1.8%	1.6%	2.8%
2030	4.6%	1.8%	1.6%	2.8%
2031	2.0%	0.6%	0.6%	0.6%
2032	2.4%	0.6%	0.6%	0.6%
2033	2.1%	0.6%	0.6%	0.6%
2034	1.9%	0.6%	0.6%	0.6%
2035	1.9%	0.6%	0.6%	0.6%
2036	1.8%	0.6%	0.6%	0.6%
2037	1.7%	0.6%	0.6%	0.6%
2038	1.6%	0.6%	0.6%	0.6%
2039	2.1%	0.6%	0.6%	0.6%
2040	1.6%	0.6%	0.6%	0.6%
2041	2.2%	0.6%	0.6%	0.6%
2042	2.2%	0.6%	0.6%	0.6%
2043	2.3%	0.6%	0.6%	0.6%
2044	2.4%	0.6%	0.6%	0.6%
2045	2.5%	0.6%	0.6%	0.6%
2046	1.5%	0.6%	0.6%	0.6%
2047	1.3%	0.6%	0.6%	0.6%
2048	1.6%	0.6%	0.6%	0.6%
2049	1.3%	0.6%	0.6%	0.6%
2050	1.5%	0.6%	0.6%	0.6%
2051	1.8%	0.6%	0.6%	0.6%
2052	1.8%	0.6%	0.6%	0.6%
2053	1.8%	0.6%	0.6%	0.6%

[28] https://www.energy.ca.gov/files/2025-energy-code-hourly-factors. Actual escalation factors were provided by consultants E3.

Table 29: Real Utility Rate Escalation Rate Assumptions, 2025 LSC Basis

Year	Statewide Natural Gas Residential Average Rate (%/year, real)	Statewide Electricity Residential Average Rate (%/year, real)
2024	4.6%	2.1%
2025	4.6%	2.1%
2026	4.6%	2.1%
2027	4.2%	0.6%
2028	3.2%	1.9%
2029	3.6%	1.6%
2030	6.6%	1.3%
2031	6.7%	1.0%
2032	7.7%	1.2%
2033	8.2%	1.1%
2034	8.2%	1.1%
2035	8.2%	0.9%
2036	8.2%	1.1%
2037	8.2%	1.1%
2038	8.2%	1.0%
2039	8.2%	1.1%
2040	8.2%	1.1%
2041	8.2%	1.1%
2042	8.2%	1.1%
2043	8.2%	1.1%
2044	8.2%	1.1%
2045	8.2%	1.1%
2046	8.2%	1.1%
2047	3.1%	1.1%
2048	-0.5%	1.1%
2049	-0.6%	1.1%
2050	-0.5%	1.1%
2051	-0.6%	1.1%
2052	-0.6%	1.1%
2053	-0.6%	1.1%

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CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Application of the 2022 Studies to the 2025 Energy Code:
Existing Single Family Building Upgrades

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SDGE™ SOUTHERN CALIFORNIA EDISON® Energy for What's Ahead® PG&E Pacific Gas and Electric Company®

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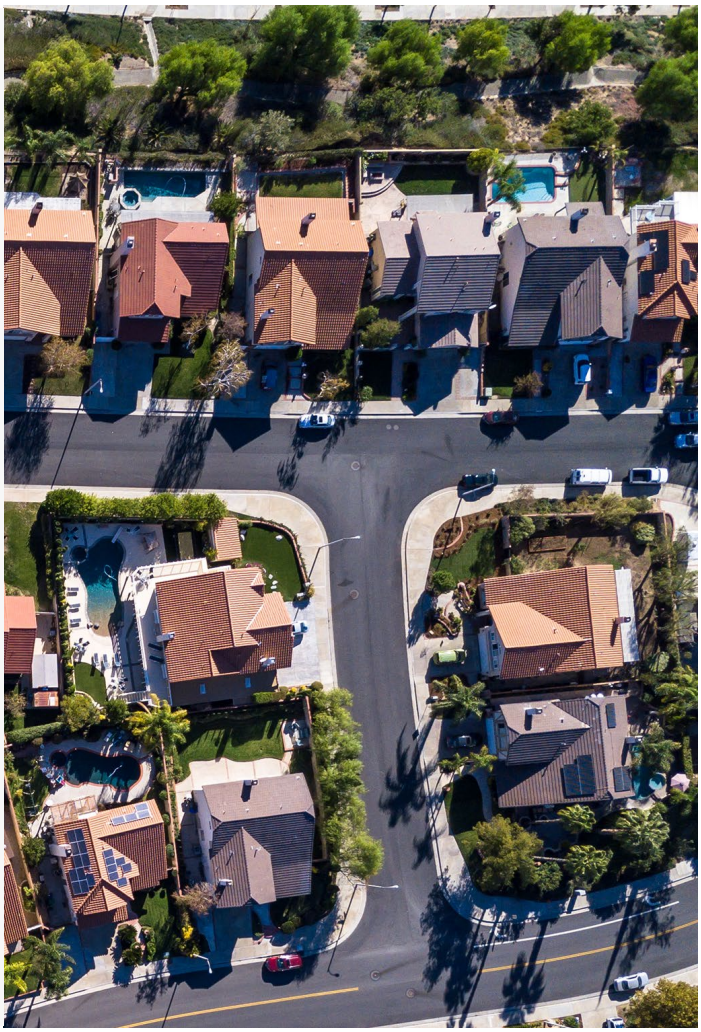

Table 1 Summary of Revisions

Date	Description	Reference (page or section)
8/15/2025	Original Release	N/A

Acronym List

B/C – Lifecycle Benefit-to-Cost Ratio

CASE – Codes and Standards Enhancement

CFL – Compact Fluorescent Lamps

CPAU – City of Palo Alto Utilities

CPUC – California Public Utilities Commission

CZ – California Climate Zone

kWh – Kilowatt Hour

NPV – Net Present Value

PG&E – Pacific Gas and Electric Company

PV – Photovoltaic

SCE – Southern California Edison

SDG&E – San Diego Gas and Electric

SMUD – Sacramento Municipal Utility District

SoCalGas – Southern California Gas Company

Therm – Unit for quantity of heat that equals 100,000 British thermal units

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1 Summary

The California Codes and Standards (C&S) Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy efficiency and greenhouse gas reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

In April 2024, the Statewide Reach Codes Team published the 2022 Cost-Effectiveness Study: Existing Single Family Building Upgrades. This study focuses on existing single family buildings identifying cost-effective measures and measure package upgrades in all 16 California climate zones. The study was conducted to complement Part 6 of the California Building Code (the Energy Code) for the 2022 code cycle, effective January 1, 2023. In the 2019 code cycle the 2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades study included outdoor lighting and a water heater package that was discontinued in the 2022 study but has been brought back in this memo by request from jurisdictions. The studies document the estimated costs, benefits, energy impacts and greenhouse gas emission reductions that may result from implementing an ordinance to help local leadership, residents, and other stakeholders make informed policy decisions.

The Statewide Reach Codes Team reviewed the cost-effectiveness study for impacts of code changes implemented in the 2025 Energy Code. Measures that are now required by code may alter the results presented in the 2022 study. Below is a summary of the changes to the additions and alterations for residential buildings sections of the 2025 Energy Code.

- Mandatory wall insulation R-value has been increased from R-13 to R-15. [Section 150.2(a) of the Energy Code]
- Prescriptive window U-factor has decreased from 0.30 to 0.27 in Climate Zones 1-5, 11-14, and 16. [Section 150.2(b)1B of the Energy Code]

The wall insulation measure has been re-evaluated with R-15 instead of R-13. There is generally a slight increase in utility cost savings as expected with the increase in efficiency. However, there is not a substantial impact on the cost-effectiveness results.

For the prescriptive window U-factor, the original study modeled U-0.28 in all climate zones. This updated memo drops the U-factor from 0.28 to 0.27 in all climate zones. The SHGC is maintained at 0.23 for climate zone 2, 4, and 6-15 and 0.35 for CZ 1, 3, 5, 16. There is minimal impact on the cost-effectiveness results due to this update. However, there are two instances in the 1978-1991 vintage where cost-effectiveness flips from cost-effective to not cost-effective. Climate zone 4 in PGE territory utilizing standard rates and the modest gas escalation is no longer cost-effective on-bill by the smallest margin. Climate zone 10 in SDGE territory utilizing CARE rates and the modest gas escalation has also become no longer cost-effective on-bill.

The 2022 study included a whole building air sealing measure defined as a 30% reduction in air leakage. A new measure – air sealing of the ceiling floor, representing a 14% reduction in air leakage – is added in this memo. Further details and cost-effectiveness results are provided in Section 2.

Lighting measures were previously presented in the 2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades study but were not analyzed in the 2022 study. Updated cost-effectiveness analysis for this measure is presented in Section 3.

The water heating package measure was previously presented in 2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades study. Updated cost-effectiveness analysis for this measure is presented in Section 4.

The 3 kW PV measure from the 2022 study is revised here with an updated cost-effectiveness analysis that accounts for the elimination of the Federal Solar tax credit December 31, 2025. Additional details and analysis are provided in Section 5.

The 2022 report, model ordinance language and other resources are posted on the C&S Reach Codes Program website at LocalEnergyCodes.com. Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at info@localenergycodes.com.

2 Air Sealing at the Ceiling

Unlike full air sealing, which has previously been presented, air sealing of the ceiling floor may be an attractive measure for an attic remodel project. The whole building air sealing measure estimated a 30% reduction in air leakage, while air sealing at the ceiling measure results in a 14% reduction in air leakage.

Table 2 through Table 7 present the cost-effectiveness results for the air sealing at the ceiling plane measure. The estimated incremental cost for air sealing at the ceiling plane is $1,963 which is from the 2022 Residential Additions and Alterations CASE Report (Statewide CASE Team, 2020).

Table 2. [Pre-1978] Air Sealing at the Ceiling (Std)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$1,963	$33	($465)	($997)	($432)
CZ02	PGE	$1,963	$18	($1,114)	($1,433)	($1,118)
CZ03	PGE	$1,963	$17	($1,180)	($1,463)	($1,171)
CZ04	PGE	$1,963	$25	($1,081)	($1,290)	($979)
CZ04	CPAU	$1,963	$21	($1,081)	($1,379)	($1,069)
CZ05	PGE	$1,963	$16	($1,230)	($1,500)	($1,235)
CZ05	PGE/SCG	$1,963	$14	($1,230)	($1,555)	($1,325)
CZ06	SCE/SCG	$1,963	($2)	($1,797)	($1,987)	($1,937)
CZ07	SDGE	$1,963	($3)	($1,813)	($2,008)	($1,934)
CZ08	SCE/SCG	$1,963	$7	($1,680)	($1,775)	($1,703)
CZ09	SCE/SCG	$1,963	$10	($1,597)	($1,693)	($1,592)
CZ10	SCE/SCG	$1,963	$17	($1,497)	($1,540)	($1,420)
CZ10	SDGE	$1,963	$23	($1,497)	($1,366)	($1,237)
CZ11	PGE	$1,963	$32	($1,014)	($1,120)	($816)
CZ12	PGE	$1,963	$22	($1,147)	($1,348)	($1,064)
CZ12	SMUD/PGE	$1,963	$17	($1,147)	($1,468)	($1,190)
CZ13	PGE	$1,963	$31	($1,114)	($1,162)	($918)
CZ14	SCE/SCG	$1,963	$32	($897)	($1,130)	($832)
CZ14	SDGE	$1,963	$42	($897)	($845)	($519)
CZ15	SCE/SCG	$1,963	$40	($1,297)	($1,041)	($946)
CZ16	PGE	$1,963	$30	($581)	($1,071)	($551)

Table 3. [1978-1991] Air Sealing at the Ceiling (Std)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$1,963	$23	($931)	($1,292)	($903)
CZ02	PGE	$1,963	$13	($1,364)	($1,570)	($1,341)
CZ03	PGE	$1,963	$10	($1,480)	($1,668)	($1,496)
CZ04	PGE	$1,963	$16	($1,330)	($1,522)	($1,292)
CZ04	CPAU	$1,963	$13	($1,330)	($1,575)	($1,356)
CZ05	PGE	$1,963	$11	($1,447)	($1,649)	($1,466)
CZ05	PGE/SCG	$1,963	$10	($1,447)	($1,684)	($1,522)
CZ06	SCE/SCG	$1,963	($1)	($1,830)	($1,967)	($1,934)
CZ07	SDGE	$1,963	($4)	($1,896)	($2,040)	($1,991)
CZ08	SCE/SCG	$1,963	$4	($1,797)	($1,860)	($1,813)
CZ09	SCE/SCG	$1,963	$5	($1,747)	($1,823)	($1,764)
CZ10	SCE/SCG	$1,963	$10	($1,663)	($1,722)	($1,652)
CZ10	SDGE	$1,963	$14	($1,663)	($1,603)	($1,517)
CZ11	PGE	$1,963	$25	($1,264)	($1,320)	($1,096)
CZ12	PGE	$1,963	$16	($1,380)	($1,520)	($1,314)
CZ12	SMUD/PGE	$1,963	$12	($1,380)	($1,604)	($1,402)
CZ13	PGE	$1,963	$23	($1,364)	($1,373)	($1,199)
CZ14	SCE/SCG	$1,963	$22	($1,230)	($1,397)	($1,182)
CZ14	SDGE	$1,963	$28	($1,230)	($1,212)	($974)
CZ15	SCE/SCG	$1,963	$32	($1,463)	($1,225)	($1,154)
CZ16	PGE	$1,963	$21	($1,014)	($1,357)	($1,001)

Table 4. [1992-2010] Air Sealing at the Ceiling (Std)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$1,963	$14	($1,314)	($1,550)	($1,309)
CZ02	PGE	$1,963	$9	($1,530)	($1,687)	($1,529)
CZ03	PGE	$1,963	$7	($1,613)	($1,744)	($1,618)
CZ04	PGE	$1,963	$11	($1,530)	($1,653)	($1,501)
CZ04	CPAU	$1,963	$9	($1,530)	($1,701)	($1,557)
CZ05	PGE	$1,963	$7	($1,613)	($1,759)	($1,637)
CZ05	PGE/SCG	$1,963	$6	($1,613)	($1,788)	($1,686)
CZ06	SCE/SCG	$1,963	$1	($1,863)	($1,936)	($1,911)
CZ07	SDGE	$1,963	$0	($1,896)	($1,944)	($1,911)
CZ08	SCE/SCG	$1,963	$3	($1,830)	($1,885)	($1,851)
CZ09	SCE/SCG	$1,963	$3	($1,780)	($1,892)	($1,853)
CZ10	SCE/SCG	$1,963	$6	($1,763)	($1,814)	($1,767)
CZ10	SDGE	$1,963	$8	($1,763)	($1,741)	($1,681)
CZ11	PGE	$1,963	$14	($1,530)	($1,581)	($1,437)
CZ12	PGE	$1,963	$10	($1,580)	($1,693)	($1,560)
CZ12	SMUD/PGE	$1,963	$8	($1,580)	($1,737)	($1,606)
CZ13	PGE	$1,963	$12	($1,580)	($1,643)	($1,531)
CZ14	SCE/SCG	$1,963	$12	($1,530)	($1,639)	($1,503)
CZ14	SDGE	$1,963	$16	($1,530)	($1,537)	($1,382)
CZ15	SCE/SCG	$1,963	$17	($1,680)	($1,572)	($1,532)
CZ16	PGE	$1,963	$14	($1,314)	($1,556)	($1,314)

Table 5. [Pre-1978] Air Sealing at the Ceiling (CARE)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$1,963	$26	($465)	($1,212)	($766)
CZ02	PGE	$1,963	$14	($1,114)	($1,550)	($1,302)
CZ03	PGE	$1,963	$13	($1,180)	($1,574)	($1,343)
CZ04	PGE	$1,963	$18	($1,081)	($1,459)	($1,216)
CZ04	CPAU	$1,963	$0	($1,081)	($1,963)	($1,963)
CZ05	PGE	$1,963	$12	($1,230)	($1,604)	($1,395)
CZ05	PGE/SCG	$1,963	$11	($1,230)	($1,648)	($1,467)
CZ06	SCE/SCG	$1,963	($1)	($1,797)	($1,969)	($1,928)
CZ07	SDGE	$1,963	($1)	($1,813)	($1,976)	($1,918)
CZ08	SCE/SCG	$1,963	$5	($1,680)	($1,824)	($1,768)
CZ09	SCE/SCG	$1,963	$8	($1,597)	($1,764)	($1,686)
CZ10	SCE/SCG	$1,963	$12	($1,497)	($1,659)	($1,566)
CZ10	SDGE	$1,963	$16	($1,497)	($1,546)	($1,443)
CZ11	PGE	$1,963	$23	($1,014)	($1,353)	($1,116)
CZ12	PGE	$1,963	$17	($1,147)	($1,503)	($1,279)
CZ12	SMUD/PGE	$1,963	$11	($1,147)	($1,623)	($1,406)
CZ13	PGE	$1,963	$22	($1,114)	($1,394)	($1,205)
CZ14	SCE/SCG	$1,963	$23	($897)	($1,352)	($1,120)
CZ14	SDGE	$1,963	$30	($897)	($1,163)	($905)
CZ15	SCE/SCG	$1,963	$27	($1,297)	($1,334)	($1,266)
CZ16	PGE	$1,963	$24	($581)	($1,270)	($859)

Table 6. [1978-1991] Air Sealing at the Ceiling (CARE)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$1,963	$18	($931)	($1,442)	($1,135)
CZ02	PGE	$1,963	$10	($1,364)	($1,658)	($1,477)
CZ03	PGE	$1,963	$8	($1,480)	($1,734)	($1,598)
CZ04	PGE	$1,963	$12	($1,330)	($1,627)	($1,446)
CZ04	CPAU	$1,963	$0	($1,330)	($1,963)	($1,963)
CZ05	PGE	$1,963	$8	($1,447)	($1,719)	($1,575)
CZ05	PGE/SCG	$1,963	$7	($1,447)	($1,746)	($1,619)
CZ06	SCE/SCG	$1,963	($0)	($1,830)	($1,959)	($1,933)
CZ07	SDGE	$1,963	($2)	($1,896)	($2,003)	($1,964)
CZ08	SCE/SCG	$1,963	$3	($1,797)	($1,886)	($1,848)
CZ09	SCE/SCG	$1,963	$4	($1,747)	($1,859)	($1,813)
CZ10	SCE/SCG	$1,963	$7	($1,663)	($1,790)	($1,736)
CZ10	SDGE	$1,963	$10	($1,663)	($1,710)	($1,641)
CZ11	PGE	$1,963	$18	($1,264)	($1,500)	($1,325)
CZ12	PGE	$1,963	$12	($1,380)	($1,631)	($1,469)
CZ12	SMUD/PGE	$1,963	$8	($1,380)	($1,716)	($1,558)
CZ13	PGE	$1,963	$16	($1,364)	($1,545)	($1,411)
CZ14	SCE/SCG	$1,963	$16	($1,230)	($1,545)	($1,378)
CZ14	SDGE	$1,963	$20	($1,230)	($1,422)	($1,233)
CZ15	SCE/SCG	$1,963	$22	($1,463)	($1,460)	($1,410)
CZ16	PGE	$1,963	$16	($1,014)	($1,491)	($1,211)

Table 7. [1991-2010] Air Sealing at the Ceiling (CARE)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	First-year Utility Savings	Lifecycle NPV Savings		
				2025 LSC NPV	On-Bill NPV Modest Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$1,963	$11	($1,314)	($1,642)	($1,452)
CZ02	PGE	$1,963	$7	($1,530)	($1,749)	($1,625)
CZ03	PGE	$1,963	$6	($1,613)	($1,793)	($1,693)
CZ04	PGE	$1,963	$8	($1,530)	($1,729)	($1,609)
CZ04	CPAU	$1,963	$0	($1,530)	($1,963)	($1,963)
CZ05	PGE	$1,963	$5	($1,613)	($1,804)	($1,708)
CZ05	PGE/SCG	$1,963	$5	($1,613)	($1,827)	($1,747)
CZ06	SCE/SCG	$1,963	$1	($1,863)	($1,940)	($1,920)
CZ07	SDGE	$1,963	$0	($1,896)	($1,944)	($1,918)
CZ08	SCE/SCG	$1,963	$2	($1,830)	($1,905)	($1,879)
CZ09	SCE/SCG	$1,963	$2	($1,780)	($1,908)	($1,878)
CZ10	SCE/SCG	$1,963	$4	($1,763)	($1,855)	($1,819)
CZ10	SDGE	$1,963	$6	($1,763)	($1,805)	($1,758)
CZ11	PGE	$1,963	$10	($1,530)	($1,685)	($1,572)
CZ12	PGE	$1,963	$7	($1,580)	($1,759)	($1,654)
CZ12	SMUD/PGE	$1,963	$5	($1,580)	($1,802)	($1,700)
CZ13	PGE	$1,963	$9	($1,580)	($1,732)	($1,644)
CZ14	SCE/SCG	$1,963	$9	($1,530)	($1,722)	($1,615)
CZ14	SDGE	$1,963	$11	($1,530)	($1,652)	($1,529)
CZ15	SCE/SCG	$1,963	$12	($1,680)	($1,696)	($1,667)
CZ16	PGE	$1,963	$11	($1,314)	($1,645)	($1,454)

3 Lighting Measures

LED lighting and exterior lighting control measures were previously evaluated in the 2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades study. These measures are not included in the 2022 Cost-Effectiveness Study: Existing Single Family Building Upgrades study, but have been re-evaluated and included in this memo. The updated analysis follows the same methodology as the 2019 study, but with updated costs for equipment and updated utility rates.

The three measures evaluated are LED lighting, exterior photosensor, and LED lighting plus photosensor. Table 8 through Table 10 show the results for the different lighting measures evaluated. Each measure is explained in more detail below.

LED Lighting: Replace screw-in (A-based for lamps) incandescent lamps and compact fluorescent lamps (CFLs) with light-emitting diode (LED) A-lamps. This analysis was conducted external to the energy model and evaluated replacement of a 13 W CFL lamp with an 9.6 W LED lamp operating 620 hours annually. Annual hour estimates were based on whole building average hours of operation from a 2010 lighting study by KEMA (KEMA, 2010). Lifetime assumptions were 10,000 hours for CFLs and 25,000 hours for LED lamps. For incremental cost calculations it was assumed CFLs have a lifetime of 15 years, are installed five years prior to the retrofit, and would need to be replaced at year ten and 25.

Exterior Lighting Controls/Photosensor: Evaluation of exterior lighting controls was completed on a per-luminaire basis external to the energy model and assumes a screw-in photosensor control is installed in outdoor lighting luminaires. Energy savings of 12.1 kWh per year was applied based on analysis done by the Consortium for Energy Efficiency, assuming LED lamps, 2.6 hours per day of operation, and that photosensor controls reduce operating hours on average 20 percent each day (CEE, 2014). Energy savings will be higher for incandescent or CFL luminaires.

Exterior Lighting Controls/Photosensor+LED: An additional evaluation was completed for exterior lighting controls on a per-luminaire basis external to the energy model and assumes a screw-in photosensor control is installed in outdoor lighting luminaires and incandescent lamps CFLs are replaced with light-emitting diode (LED) A-lamps. Energy savings of 14.3 kWh per year was applied based on the sum of the LED lighting and Exterior Lighting Controls with Photosensor kWh energy savings.

For the measures including a LED, a cost of $3.49 for LED dimmable A19 lamp 60 W equivalent is used. A cost of $1.74 is used for an equivalent CFL product which was used to estimate total replacement costs at years 10 and 25. Costs are based on a single LED lamp replacement. For the photosensor, an incremental cost of $12.62, based on a screw-in photosensor control, was obtained from an on-line product search of available products. A five-year lifetime for this type of control was assumed.

Table 8. [All Vintages] LED Lamp vs. CFL

Climate Zone	Electric/ Gas Utility	Measure Cost	Electricity Savings	First Year Utility Cost Savings	Customer On-Bill Modest Gas Escalation		Customer On-Bill High Gas Escalation	
					B/C Ratio	NPV	B/C Ratio	NPV
CZ01	PGE	$1.75	2.2	$0.77	10.05	$15.82	10.58	$16.74
CZ02	PGE	$1.75	2.2	$0.86	11.26	$17.94	11.85	$18.98
CZ03	PGE	$1.75	2.2	$0.78	10.14	$15.99	10.68	$16.92
CZ04	PGE	$1.75	2.2	$0.80	10.39	$16.42	10.94	$17.38
CZ04	CPAU	$1.75	2.2	$0.41	5.32	$7.56	5.60	$8.05
CZ05	PGE	$1.75	2.2	$0.78	10.14	$15.99	10.67	$16.92
CZ05	PGE/SCG	$1.75	2.2	$0.78	10.14	$15.99	10.67	$16.92
CZ06	SCE/SCG	$1.75	2.2	$0.66	8.44	$13.01	8.99	$13.97
CZ07	SDGE	$1.75	2.2	$0.95	13.15	$21.24	13.03	$21.04
CZ08	SCE/SCG	$1.75	2.2	$0.74	9.51	$14.89	10.14	$15.98
CZ09	SCE/SCG	$1.75	2.2	$0.71	9.17	$14.29	9.77	$15.33
CZ10	SCE/SCG	$1.75	2.2	$0.73	9.38	$14.65	9.99	$15.72
CZ10	SDGE	$1.75	2.2	$1.07	14.86	$24.24	14.74	$24.02
CZ11	PGE	$1.75	2.2	$0.85	11.05	$17.57	11.63	$18.59
CZ12	PGE	$1.75	2.2	$0.79	10.32	$16.29	10.86	$17.24
CZ12	SMUD/PGE	$1.75	2.2	$0.47	6.08	$8.88	6.40	$9.44
CZ13	PGE	$1.75	2.2	$0.86	11.27	$17.96	11.86	$19.00
CZ14	SCE/SCG	$1.75	2.2	$0.74	9.58	$15.00	10.21	$16.10
CZ14	SDGE	$1.75	2.2	$1.06	14.68	$23.93	14.56	$23.71
CZ15	SCE/SCG	$1.75	2.2	$0.78	10.01	$15.75	10.66	$16.90
CZ16	PGE	$1.75	2.2	$0.77	9.98	$15.71	10.51	$16.62

Table 9. [All Vintages] Exterior Photosensor

Climate Zone	Electric/ Gas Utility	Measure Cost	Electricity Savings	First Year Utility Cost Savings	Customer On-Bill Modest Gas Escalation		Customer On-Bill High Gas Escalation	
					B/C Ratio	NPV	B/C Ratio	NPV
CZ01	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ02	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ03	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ04	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ04	CPAU	$54.03	12.1	$2.12	0.89	($5.69)	0.94	($3.15)
CZ05	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ05	PGE/SCG	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ06	SCE/SCG	$54.03	12.1	$3.48	1.45	$24.36	1.55	$29.48
CZ07	SDGE	$54.03	12.1	$5.07	2.27	$68.58	2.25	$67.53
CZ08	SCE/SCG	$54.03	12.1	$3.48	1.45	$24.36	1.55	$29.48
CZ09	SCE/SCG	$54.03	12.1	$3.48	1.45	$24.36	1.55	$29.48
CZ10	SCE/SCG	$54.03	12.1	$3.48	1.45	$24.36	1.55	$29.48
CZ10	SDGE	$54.03	12.1	$5.07	2.27	$68.58	2.25	$67.53
CZ11	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ12	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ12	SMUD/PGE	$54.03	12.1	$1.46	0.62	($20.73)	0.65	($18.98)
CZ13	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74
CZ14	SCE/SCG	$54.03	12.1	$3.48	1.45	$24.36	1.55	$29.48
CZ14	SDGE	$54.03	12.1	$5.07	2.27	$68.58	2.25	$67.53
CZ15	SCE/SCG	$54.03	12.1	$3.48	1.45	$24.36	1.55	$29.48
CZ16	PGE	$54.03	12.1	$4.16	1.75	$40.75	1.85	$45.74

Table 10. [All Vintages] LED and Photosensor

Climate Zone	Electric/ Gas Utility	Measure Cost	Electricity Savings	First Year Utility Cost Savings	Customer On-Bill Modest Gas Escalation		Customer On-Bill High Gas Escalation	
					B/C Ratio	NPV	B/C Ratio	NPV
CZ01	PGE	$55.77	14.3	$4.93	2.01	$56.57	2.12	$62.48
CZ02	PGE	$55.77	14.3	$5.02	2.05	$58.70	2.16	$64.72
CZ03	PGE	$55.77	14.3	$4.94	2.02	$56.74	2.12	$62.66
CZ04	PGE	$55.77	14.3	$4.95	2.03	$57.17	2.13	$63.12
CZ04	CPAU	$55.77	14.3	$2.53	1.03	$1.87	1.09	$4.90
CZ05	PGE	$55.77	14.3	$4.94	2.02	$56.74	2.12	$62.66
CZ05	PGE/SCG	$55.77	14.3	$4.94	2.02	$56.74	2.12	$62.66
CZ06	SCE/SCG	$55.77	14.3	$4.13	1.67	$37.37	1.78	$43.45
CZ07	SDGE	$55.77	14.3	$6.02	2.61	$89.82	2.59	$88.57
CZ08	SCE/SCG	$55.77	14.3	$4.22	1.70	$39.25	1.82	$45.46
CZ09	SCE/SCG	$55.77	14.3	$4.19	1.69	$38.65	1.80	$44.82
CZ10	SCE/SCG	$55.77	14.3	$4.21	1.70	$39.01	1.81	$45.20
CZ10	SDGE	$55.77	14.3	$6.14	2.66	$92.82	2.64	$91.55
CZ11	PGE	$55.77	14.3	$5.00	2.05	$58.33	2.15	$64.33
CZ12	PGE	$55.77	14.3	$4.95	2.02	$57.05	2.13	$62.98
CZ12	SMUD/PGE	$55.77	14.3	$1.93	0.79	($11.85)	0.83	($9.54)
CZ13	PGE	$55.77	14.3	$5.02	2.05	$58.71	2.16	$64.73
CZ14	SCE/SCG	$55.77	14.3	$4.22	1.71	$39.37	1.82	$45.58
CZ14	SDGE	$55.77	14.3	$6.13	2.66	$92.51	2.64	$91.24
CZ15	SCE/SCG	$55.77	14.3	$4.26	1.72	$40.12	1.83	$46.38
CZ16	PGE	$55.77	14.3	$4.92	2.01	$56.46	2.12	$62.36

4 Water Heating Package

This package includes the following:

- R-6 water heater blanket
- R-3 hot water pipe insulation
- Low flow fixtures: two low flow showerheads and three sink aerators.

This analysis assumes the homeowner installs these measures themselves and therefore no labor costs. Costs are based on Home Depot prices from August of 2025. The water heater package is evaluated over a 15-year analysis period and assumes the modest gas escalation rate.

Table 11. [All Vintages] Water Heating Package

Climate Zone	Electric/ Gas Utility	Measure Cost	Gas Savings (therms)	First Year Utility Cost Savings	Customer On-Bill	
					B/C Ratio	NPV
CZ01	PGE	$125.68	14.69	$31.11	3.96	$371.76
CZ02	PGE	$125.68	15.60	$35.20	4.48	$437.15
CZ03	PGE	$125.68	15.70	$31.43	4.00	$376.88
CZ04	PGE	$125.68	16.05	$32.62	4.15	$395.78
CZ04	CPAU	$125.68	16.05	$31.99	4.07	$385.77
CZ05	PGE	$125.68	15.83	$31.37	3.99	$375.88
CZ05	PGE/SCG	$125.68	15.83	$28.29	3.60	$326.59
CZ06	SCE/SCG	$125.68	16.67	$29.18	3.71	$340.84
CZ07	SDGE	$125.68	16.75	$37.25	4.74	$469.81
CZ08	SCE/SCG	$125.68	16.78	$29.36	3.74	$343.80
CZ09	SCE/SCG	$125.68	16.66	$29.27	3.72	$342.34
CZ10	SCE/SCG	$125.68	16.58	$28.99	3.69	$337.73
CZ10	SDGE	$125.68	16.58	$37.77	4.80	$478.19
CZ11	PGE	$125.68	15.87	$32.96	4.19	$401.32
CZ12	PGE	$125.68	15.90	$32.85	4.18	$399.47
CZ12	SMUD/PGE	$125.68	15.90	$32.85	4.18	$399.47
CZ13	PGE	$125.68	16.32	$33.00	4.20	$401.93
CZ14	SCE/SCG	$125.68	16.11	$29.79	3.79	$350.57
CZ14	SDGE	$125.68	16.11	$39.23	4.99	$501.49
CZ15	SCE/SCG	$125.68	17.40	$30.16	3.84	$356.50
CZ16	PGE	$125.68	15.14	$31.75	4.04	$381.87

5 PV

The results for 3 kW PV have been updated from the 2022 study to remove the federal solar tax credit from the cost-effectiveness calculations. The removal of the solar tax credit has a substantial impact on many climate zones across all vintages and will impact the FlexPath.

The following describes the impacts and changes to cost-effectiveness from the 2022 study. These observations are utilizing standard rates. Previously, with the solar tax credit, the 3 kW PV measure in the pre-1978 vintage was on-bill cost effective in all climate zones using both the modest and high gas escalation rates. However, with the credit removed, Climate Zones 1-3, 5, 6, and 12 are no longer cost effective on-bill for both the modest and high gas escalations.

Previously for the 1978-1991 vintage the only cases that were not on-bill cost effective were climate zones 2 and 6 utilizing the modest gas escalation. Now, with the credit removed, many more climate zones are no longer cost effective. Using the modest gas escalation, climate zones 1-3, 5, 6, 12, and 16 are not cost effective on-bill. Using the high gas escalation, climate zones 1-3, 5, 6, and 12 (SMUD) are not cost effective on-bill.

Previously for the 1992-2010 vintage the following cases were not cost effective on-bill: climate zones 1-3, 5, and 6 utilizing the modest gas escalation and climate zone 6 using the high gas escalation. With the credit removed an increased number of climate zones are no longer cost effective. Using the modest gas escalation, climate zones 1-3, 4 (PGE) 5-9, 10 (SCE/SCG),12, and 16 are not cost effective on-bill. Using the high gas escalation, climate zones 1-3, 4 (PGE), 5-7, 9, 12, and 16 are not cost effective on-bill.

The cost-effectiveness results are presented in Table 12 through Table 1717.

Table 12. [Pre-1978] 3 kW PV without Solar Tax Credit (Std)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	On-Bill Savings			
			On-Bill B/C Modest Gas Escalation	On-Bill NPV Modest Gas Escalation	On-Bill B/C High Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$13,726	0.80	($3,074)	0.85	($2,410)
CZ02	PGE	$13,726	0.80	($3,072)	0.85	($2,409)
CZ03	PGE	$13,726	0.77	($3,567)	0.81	($2,930)
CZ04	PGE	$13,726	1.11	$1,652	1.16	$2,564
CZ04	CPAU	$13,726	1.38	$5,983	1.45	$7,123
CZ05	PGE	$13,726	0.78	($3,431)	0.82	($2,786)
CZ05	PGE/SCG	$13,726	0.78	($3,431)	0.82	($2,786)
CZ06	SCE/SCG	$13,726	0.87	($2,118)	0.92	($1,231)
CZ07	SDGE	$13,726	1.31	$4,886	1.30	$4,711
CZ08	SCE/SCG	$13,726	1.30	$4,655	1.38	$5,984
CZ09	SCE/SCG	$13,726	1.18	$2,821	1.26	$4,030
CZ10	SCE/SCG	$13,726	1.29	$4,622	1.38	$5,948
CZ10	SDGE	$13,726	1.99	$15,550	1.97	$15,284
CZ11	PGE	$13,726	1.55	$8,684	1.64	$9,967
CZ12	PGE	$13,726	1.07	$1,117	1.13	$2,002
CZ12	SMUD/PGE	$13,726	0.93	($1,109)	0.98	($342)
CZ13	PGE	$13,726	1.80	$12,597	1.90	$14,085
CZ14	SCE/SCG	$13,726	1.58	$9,098	1.68	$10,717
CZ14	SDGE	$13,726	2.15	$17,983	2.13	$17,695
CZ15	SCE/SCG	$13,726	2.24	$19,477	2.39	$21,774
CZ16	PGE	$13,726	1.04	$579	1.09	$1,435

Table 13. [1978-1991] 3 kW PV without Solar Tax Credit (Std)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	On-Bill Savings			
			On-Bill B/C Modest Gas Escalation	On-Bill NPV Modest Gas Escalation	On-Bill B/C High Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$13,726	0.77	($3,570)	0.81	($2,932)
CZ02	PGE	$13,726	0.71	($4,549)	0.75	($3,963)
CZ03	PGE	$13,726	0.74	($4,106)	0.78	($3,497)
CZ04	PGE	$13,726	1.00	$7	1.05	$833
CZ04	CPAU	$13,726	1.35	$5,517	1.42	$6,633
CZ05	PGE	$13,726	0.75	($3,985)	0.79	($3,369)
CZ05	PGE/SCG	$13,726	0.75	($3,985)	0.79	($3,369)
CZ06	SCE/SCG	$13,726	0.73	($4,249)	0.78	($3,501)
CZ07	SDGE	$13,726	1.17	$2,623	1.16	$2,466
CZ08	SCE/SCG	$13,726	1.20	$3,086	1.27	$4,313
CZ09	SCE/SCG	$13,726	1.09	$1,487	1.17	$2,609
CZ10	SCE/SCG	$13,726	1.18	$2,884	1.26	$4,097
CZ10	SDGE	$13,726	1.85	$13,356	1.84	$13,108
CZ11	PGE	$13,726	1.41	$6,420	1.48	$7,583
CZ12	PGE	$13,726	0.97	($512)	1.02	$287
CZ12	SMUD/PGE	$13,726	0.93	($1,109)	0.98	($342)
CZ13	PGE	$13,726	1.63	$9,953	1.72	$11,302
CZ14	SCE/SCG	$13,726	1.42	$6,655	1.52	$8,115
CZ14	SDGE	$13,726	2.00	$15,653	1.98	$15,386
CZ15	SCE/SCG	$13,726	1.94	$14,686	2.06	$16,670
CZ16	PGE	$13,726	0.95	($737)	1.00	$49

Table 1414. [1992-2010] 3 kW PV without Solar Tax Credit (Std)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	On-Bill Savings			
			On-Bill B/C Modest Gas Escalation	On-Bill NPV Modest Gas Escalation	On-Bill B/C High Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$13,726	0.71	($4,475)	0.75	($3,885)
CZ02	PGE	$13,726	0.73	($4,198)	0.77	($3,593)
CZ03	PGE	$13,726	0.72	($4,411)	0.76	($3,817)
CZ04	PGE	$13,726	0.80	($3,121)	0.84	($2,459)
CZ04	CPAU	$13,726	1.16	$2,477	1.22	$3,433
CZ05	PGE	$13,726	0.73	($4,299)	0.76	($3,700)
CZ05	PGE/SCG	$13,726	0.73	($4,299)	0.76	($3,700)
CZ06	SCE/SCG	$13,726	0.61	($6,143)	0.65	($5,520)
CZ07	SDGE	$13,726	0.94	($931)	0.93	($1,057)
CZ08	SCE/SCG	$13,726	0.98	($242)	1.05	$767
CZ09	SCE/SCG	$13,726	0.88	($1,890)	0.94	($988)
CZ10	SCE/SCG	$13,726	0.96	($676)	1.02	$305
CZ10	SDGE	$13,726	1.51	$8,054	1.50	$7,852
CZ11	PGE	$13,726	1.10	$1,569	1.16	$2,477
CZ12	PGE	$13,726	0.80	($3,169)	0.84	($2,510)
CZ12	SMUD/PGE	$13,726	0.93	($1,109)	0.98	($342)
CZ13	PGE	$13,726	1.27	$4,170	1.33	$5,215
CZ14	SCE/SCG	$13,726	1.15	$2,295	1.22	$3,470
CZ14	SDGE	$13,726	1.66	$10,386	1.65	$10,164
CZ15	SCE/SCG	$13,726	1.37	$5,788	1.46	$7,191
CZ16	PGE	$13,726	0.81	($3,006)	0.85	($2,338)

Table 1515. [Pre-1978] 3 kW PV without Solar Tax Credit (CARE)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	On-Bill Savings			
			On-Bill B/C Modest Gas Escalation	On-Bill NPV Modest Gas Escalation	On-Bill B/C High Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$13,726	0.62	($6,030)	0.65	($5,522)
CZ02	PGE	$13,726	0.64	($5,707)	0.67	($5,182)
CZ03	PGE	$13,726	0.60	($6,344)	0.63	($5,853)
CZ04	PGE	$13,726	0.83	($2,725)	0.87	($2,042)
CZ05	PGE	$13,726	0.60	($6,266)	0.63	($5,771)
CZ05	PGE/SCG	$13,726	0.60	($6,266)	0.63	($5,771)
CZ06	SCE/SCG	$13,726	0.71	($4,578)	0.75	($3,852)
CZ07	SDGE	$13,726	0.71	($4,508)	0.71	($4,604)
CZ08	SCE/SCG	$13,726	0.97	($483)	1.03	$510
CZ09	SCE/SCG	$13,726	0.90	($1,530)	0.96	($605)
CZ10	SCE/SCG	$13,726	0.97	($465)	1.03	$530
CZ10	SDGE	$13,726	1.19	$3,032	1.18	$2,872
CZ11	PGE	$13,726	1.07	$1,150	1.13	$2,036
CZ12	PGE	$13,726	0.79	($3,324)	0.83	($2,673)
CZ13	PGE	$13,726	1.23	$3,587	1.29	$4,601
CZ14	SCE/SCG	$13,726	1.17	$2,662	1.25	$3,861
CZ14	SDGE	$13,726	1.28	$4,436	1.27	$4,264
CZ15	SCE/SCG	$13,726	1.57	$8,962	1.67	$10,572
CZ16	PGE	$13,726	0.79	($3,342)	0.83	($2,692)

Table 1616. [1978-1991] 3 kW PV without Solar Tax Credit (CARE)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	On-Bill Savings			
			On-Bill B/C Modest Gas Escalation	On-Bill NPV Modest Gas Escalation	On-Bill B/C High Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$13,726	0.60	($6,343)	0.63	($5,851)
CZ02	PGE	$13,726	0.56	($6,845)	0.59	($6,380)
CZ03	PGE	$13,726	0.57	($6,757)	0.60	($6,287)
CZ04	PGE	$13,726	0.76	($3,715)	0.80	($3,085)
CZ05	PGE	$13,726	0.57	($6,686)	0.60	($6,213)
CZ05	PGE/SCG	$13,726	0.57	($6,686)	0.60	($6,213)
CZ06	SCE/SCG	$13,726	0.61	($6,195)	0.64	($5,575)
CZ07	SDGE	$13,726	0.62	($6,004)	0.61	($6,087)
CZ08	SCE/SCG	$13,726	0.91	($1,483)	0.96	($555)
CZ09	SCE/SCG	$13,726	0.85	($2,368)	0.90	($1,497)
CZ10	SCE/SCG	$13,726	0.90	($1,597)	0.96	($676)
CZ10	SDGE	$13,726	1.10	$1,560	1.09	$1,413
CZ11	PGE	$13,726	0.98	($295)	1.03	$515
CZ12	PGE	$13,726	0.72	($4,320)	0.76	($3,722)
CZ13	PGE	$13,726	1.12	$1,893	1.18	$2,818
CZ14	SCE/SCG	$13,726	1.07	$1,051	1.14	$2,144
CZ14	SDGE	$13,726	1.18	$2,878	1.17	$2,719
CZ15	SCE/SCG	$13,726	1.37	$5,735	1.45	$7,135
CZ16	PGE	$13,726	0.74	($4,126)	0.78	($3,517)

Table 1717. [1992-2010] 3 kW PV without Solar Tax Credit (CARE)

Climate Zone	Electric/ Gas Utility	First Incremental Cost	On-Bill Savings			
			On-Bill B/C Modest Gas Escalation	On-Bill NPV Modest Gas Escalation	On-Bill B/C High Gas Escalation	On-Bill NPV High Gas Escalation
CZ01	PGE	$13,726	0.56	($6,963)	0.59	($6,504)
CZ02	PGE	$13,726	0.26	($11,640)	0.20	($12,611)
CZ03	PGE	$13,726	0.55	($6,997)	0.58	($6,540)
CZ04	PGE	$13,726	0.62	($5,900)	0.66	($5,385)
CZ05	PGE	$13,726	0.56	($6,932)	0.59	($6,471)
CZ05	PGE/SCG	$13,726	0.56	($6,932)	0.59	($6,471)
CZ06	SCE/SCG	$13,726	0.51	($7,652)	0.55	($7,127)
CZ07	SDGE	$13,726	0.48	($8,115)	0.48	($8,180)
CZ08	SCE/SCG	$13,726	0.78	($3,430)	0.83	($2,629)
CZ09	SCE/SCG	$13,726	0.72	($4,462)	0.76	($3,728)
CZ10	SCE/SCG	$13,726	0.76	($3,748)	0.81	($2,968)
CZ10	SDGE	$13,726	0.86	($2,225)	0.85	($2,340)
CZ11	PGE	$13,726	0.79	($3,259)	0.83	($2,605)
CZ12	PGE	$13,726	0.63	($5,876)	0.66	($5,359)
CZ13	PGE	$13,726	0.89	($1,678)	0.94	($941)
CZ14	SCE/SCG	$13,726	0.89	($1,676)	0.95	($761)
CZ14	SDGE	$13,726	0.95	($838)	0.94	($964)
CZ15	SCE/SCG	$13,726	0.99	($142)	1.06	$873
CZ16	PGE	$13,726	0.63	($5,850)	0.66	($5,333)

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The adoption of reach codes can differentiate jurisdictions as efficiency leaders and help accelerate the adoption of new equipment, technologies, code compliance, and energy savings strategies.

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Revision: 1.0
Last modified: 2025/08/15

Ordinance No. ____

Emergency Ordinance of the Council of the City of Palo Alto Amending Chapter 16.04 (California Building Code, California Code of Regulations, Title 24, Part 2, Volumes 1 & 2) of the Palo Alto Municipal Code to Add New Local Amendments and Associated Findings Related to Certificates of Occupancy and Definitions

The Council of the City of Palo Alto does ORDAIN as follows:

SECTION 1. Findings and Declarations. The City Council finds and declares as follows:

A. Every three years, a new version of the California Building Standards Code (CBSC, or Title 24) is published. Local jurisdictions may enforce the model code as published or, subject to certain requirements, adopt local amendments.

B. Most recently, the City adopted the 2022 edition of the California Building Code with local amendments pursuant to Ordinance 5564. The purpose of this ordinance is to make additional local amendments to the Building Code to clarify types of projects exempted from Use and Occupancy certificates and make clarifying edits to the definitions section.

C. The changes shown in this ordinance are relative to the existing provisions of the Palo Alto Municipal Code (PAMC) as adopted by Ordinance 5564. The City's local amendments are more restrictive building standards than those provided in the California Building Standards Code.

D. Recent legislation, Assembly Bill (AB) 130 (2025), limits local jurisdictions' authority to amend the California Building Standards Code beginning October 1, 2025, and ending June 1, 2031. The Council desires to make these amendments effective before the AB 130 moratorium begins.

E. The Council declares that this emergency ordinance, which is effective immediately, is necessary as an emergency measure to preserve the public peace, health, or safety by ensuring that the City may enforce its local amendments to the California Building Code during the AB 130 moratorium.

F. California Health and Safety Code sections 17958.5 and 17958.7 requires that the City, in order to make changes or modifications in the requirements contained in the California Building Standards Code on the basis of local conditions, make express finding that such modifications or changes are reasonably necessary because of local climatic, geological, or topographical conditions. The required findings are attached to this ordinance as Exhibit A.

SECTION 2. Section 16.04.190 of Chapter 16.04 (California Building Code, California Code of Regulations, Title 24, Part 2, Volumes 1 & 2) of Title 16 (Building Regulations) of the Palo Alto Municipal Code is hereby amended as follows (additions

underlined and deletions ~~struck-through,~~ bracketed ellipses indicate text of the California Building Code, 2022 Edition, that has been adopted as amended by Ordinance 5564 but is omitted for brevity):

16.04.190 Section 111.1 Use and occupancy.

111.1 Use and occupancy. A building or structure shall not be used or occupied, and a change in the existing occupancy of a building or structure or portion thereof shall not be made, until the chief building official has issued a certificate of occupancy therefor as provided herein. Issuance of a certificate of occupancy shall not be construed as an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction.

Exception: Certificates of occupancy are not required or issued for:

1. Work exempted from permits under Section 105.2
2. Group R – ~~Division 2, 3 occupancies~~ Division 3 and Group U occupancies located on a single-family residential/agricultural lot.
3. ~~Group U occupancies accessory to R3 and R2 occupancies.~~ Non-residential "core and shell" or similar construction (exterior envelope and structural framework) without finalized tenant improvement(s).
4. Site development without a building or buildings as defined in section 202.

[…]

SECTION 3. Section 16.04.235 (Section 202 Definitions) is added to Chapter 16.04 (California Building Code, California Code of Regulations, Title 24, Part 2, Volumes 1 & 2) of Title 16 Building Regulations) of the Palo Alto Municipal Code to read as follows (additions underlined, bracketed ellipses indicate text of the California Building Code, 2022 Edition, that has been adopted without amendment but is omitted for brevity):

16.04.235 Section 202 Definitions

[…]

FLOOR AREA, GROSS. The floor area within the inside perimeter of the exterior walls of the building under consideration, exclusive of vent shafts and courts, without deduction for corridors, stairways, ramps, closets, the thickness of interior walls, columns or other features. The floor area of a building, or portion thereof, not provided with surrounding exterior walls shall be the usable area under the horizontal projection of the roof or floor above. The gross floor area shall not include shafts with no openings or interior courts. For the purposes of Title 18 (Zoning), the definition of "gross floor area" in Section 18.04.030 shall apply.

[…]

FLOOR AREA, NET. The actual occupied area not including unoccupied accessory areas such as corridors, stairways, ramps, toilet rooms, mechanical rooms and closets. For the purposes of Title 18 (Zoning), the definition of "net floor area" in Section 18.04.030 shall apply.

[…]

SECTION 4. The Council adopts the findings for local amendments to the California Building Code, 2022 Edition, attached hereto as Exhibit "A" and incorporated herein by reference.

SECTION 5. The Council finds that this ordinance is exempt from the provisions of the California Environmental Quality Act ("CEQA"), pursuant to Section 15061(b)(3) of the CEQA Guidelines, because it can be seen with certainty that there is no possibility that the amendments herein adopted will have a significant effect on the environment.

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SECTION 6. Pursuant to Palo Alto Municipal Code Section 2.04.270, this ordinance shall be effective immediately upon adoption if passed by a vote of four-fifths of the council members present.

INTRODUCED:

PASSED:

AYES:

NOES:

ABSENT:

ABSTENTIONS:

ATTEST:

_____
City Clerk

_____
Mayor

APPROVED AS TO FORM:

_____
City Attorney or Designee

APPROVED:

_____
City Manager

_____
Director of Planning and Development Services

_____
Director of Administrative Services

Exhibit A

FINDINGS FOR LOCAL AMENDMENTS TO CALIFORNIA BUILDING CODE, TITLE 24, PART 2, VOLUMES 1 AND 2

Section 17958 of the California Health and Safety Code provides that the City may make changes to the provisions of the California Building Standards Code. Sections 17958.5 and 17958.7 of the Health and Safety Code require that for each proposed local change to those provisions of the California Building Standards Code which regulate buildings used for human habitation, the City Council must make findings supporting its determination that each such local change is reasonably necessary because of local climatic, geological, or topographical conditions.

Local building regulations having the effect of amending the uniform codes, which were adopted by the City prior to November 23, 1970, were unaffected by the regulations of Sections 17958, 17958.5 and 17958.7 of the Health and Safety Code. Therefore, amendments to the uniform codes which were adopted by the City Council prior to November 23, 1970 and have been carried through from year to year without significant change, need no required findings. Also, amendments to provisions not regulating buildings used for human habitation do not require findings.

Code: California Building Code, Title 24, Part 2, Volumes 1 and 2					
Chapter(s), Section(s), Table(s), Appendices	**Title**	**Added**	**Amended**	**Deleted**	**Justification (See keys below)**
Ch. 1, Div. II, Part 2, Section 111.1	Use and occupancy		✓		**A**
Ch. 2, Section 202	Definitions		✓		**A**

Key to Justification for Amendments to Title 24 of the California Code of Regulations

A This is an **administrative** amendment to clarify and establish civil and administrative procedures, regulations, or rules to enforce and administer the activities by the Palo Alto Building Inspection Department. These administrative amendments do not need to meet HSC 18941.5/17958/13869 per HSC 18909(c).

C This amendment is justified on the basis of a local **climatic** condition. The seasonal climatic conditions during the late summer and fall create severe fire hazards to the public health and welfare in the City. The hot, dry weather frequently results in wild land fires on the brush covered slopes west of Interstate 280. The aforementioned conditions combined with the geological characteristics of the

hills within the City create hazardous conditions for which departure from California Building Standards Code is required. Natural gas combustion and gas appliances emit a wide range of air pollutants, such as carbon monoxide (CO), nitrogen oxides (NOx, including nitrogen dioxide (NO2)), particulate matter (PM), and formaldehyde, which according to a UCLA Study, have been linked to various acute and chronic health effects, and additionally exceed levels set by national and California-based ambient air quality standards. The burning of fossil fuels used in the generation of electric power and heating of buildings contributes to climate change, which could result in rises in sea level, including in San Francisco Bay, that could put at risk Palo Alto homes and businesses, public facilities, and Highway 101 (Bayshore Freeway), particularly the mapped Flood Hazard areas of the City. Energy efficiency is a key component in reducing GHG emissions, and construction of more energy efficient buildings can help Palo Alto reduce its share of the GHG emissions that contribute to climate change. All-electric new buildings benefit the health, safety, and welfare, of Palo Alto and its residents. Requiring all-electric construction, without gas infrastructure will reduce the amount of greenhouse gas produced in Palo Alto and will contribute to reducing the impact of climate change and the associated risks. Due to decrease in annual rain fall, Palo Alto experiences the effect of drought and water saving more than some other communities in California. Embodied carbon of concrete is a significant contributor to greenhouse gas emissions and climate change, and this amendment includes a requirement to use low-carbon concrete. Providing additional capacity for electric vehicle use reduces use of gasoline which is a major contributor to climate change.

E Green building enhances the public health and welfare by promoting the **environmental** and economic health of the City through the design, construction, maintenance, operation and deconstruction of buildings and sites by incorporating green practices into all development. The green provisions in this Chapter are designed to achieve the following goals:

(a) Increase energy efficiency in buildings;

(b) Reduce the use of natural gas in buildings which improves indoor environmental quality and health;

(c) Reduce the use of natural gas which will reduce the natural gas infrastructure and fire risk over time;

(d) Reduce the embodied carbon of concrete which reduces greenhouse gas emissions;

(e) Increase water and resource conservation;

(f) Reduce waste generated by construction and demolition projects;

(g) Provide durable buildings that are efficient and economical to own and operate;

(h) Promote the health and productivity of residents, workers, and visitors to the city;

(i) Recognize and conserve the energy embodied in existing buildings;

(j) Increase capacity for use of electric vehicles which reduces greenhouse gas emissions and improves air quality;

(k) Encourage alternative transportation; and

(l) Reduce disturbance of natural ecosystems.

G This amendment is justified on the basis of a local **geological** condition. The City of Palo Alto is subject to earthquake hazard caused by its proximity to San Andreas fault. This fault runs from Hollister, through the Santa Cruz Mountains, epicenter of the 1989 Loma Prieta earthquake, then on up the San Francisco Peninsula, then offshore at Daly City near Mussel Rock. This is the approximate location of the epicenter of the 1906 San Francisco earthquake. The other fault is Hayward Fault. This fault is about 74 mi long, situated mainly along the western base of the hills on the east side of San Francisco Bay. Both of these faults are considered major Northern California earthquake faults which may experience rupture at any time. Thus, because the City is within a seismic area which includes these earthquake faults, the modifications and changes cited herein are designed to better limit property damage as a result of seismic activity and to establish criteria for repair of damaged properties following a local emergency. Reduction or eliminating of natural gas infrastructure over time will reduce maintenance costs and fire risk in difficult geological conditions.

T The City of Palo Alto **topography** includes hillsides with narrow and winding access, which makes timely response by fire suppression vehicles difficult. Palo Alto is contiguous with the San Francisco Bay, resulting in a natural receptor for storm and waste water run-off. Also, the City of Palo Alto is located in an area that is potentially susceptible to liquefaction during a major earthquake. The surface condition consists mostly of stiff to dense sandy clay, which is highly plastic and expansive in nature. The aforementioned conditions within the City create hazardous conditions for which departure from California Building Standards Code is warranted. In addition, the reduction or elimination of natural gas infrastructure reduces the likelihood of fire or environmental damage should they become disrupted due to challenging topographic conditions during construction or repair.

Ordinance No. ____

Emergency Ordinance of the Council of the City of Palo Alto Amending Chapter 16.17 (California Energy Code, California Code of Regulations, Title 24, Part 6) of the Palo Alto Municipal Code to Adopt the 2025 California Energy Code, Along With Local Amendments Thereto, to Add FlexPath and Air Conditioner Time-of-Replacement Requirements.

The Council of the City of Palo Alto does ORDAIN as follows:

SECTION 1. Findings and Declarations.

A. The City of Palo Alto adopted a Sustainability and Climate Action Plan, or S/CAP, to meet the City's stated goal of "80 x 30": reducing greenhouse gas emissions 80% below 1990 levels by 2030.

B. The S/CAP outlines goals and key actions in eight areas, one of which is energy and more specifically, energy efficiency and electrification. The goals for the energy area of the S/CAP are to reduce GHG emissions from the direct use of natural gas in Palo Alto's building sector by at least 60% below 1990 levels (116,400 MT CO2e reduction) and to modernize the electric grid to support increased electric demand to accommodate state-of-the-art technology.

C. One key action the City is taking to accomplish those goals is to use codes and ordinances - such as the energy reach code, green building ordinance, zoning code, or other mandates - to facilitate electrification in both existing buildings and new construction projects where feasible.

D. The purpose of this ordinance is to formally adopt California Code of Regulations, Title 24, Part 6, 2025 California Energy Code, with local amendments in furtherance of the City of Palo Alto's S/CAP goals and other sustainability-related goals included in the City's 2030 Comprehensive Plan. The amendments adopted herein are more restrictive than the building standards in Title 24, Part 6.

E. Recent legislation, Assembly Bill (AB) 130 (2025), limits local jurisdictions' authority to amend the California Building Standards Code beginning October 1, 2025, and ending June 1, 2031. The Council desires to adopt these amendments before the AB 130 moratorium begins. The Council may in the future adopt additional amendments to the 2025 California Energy Code that are not subject to, or are exempt from, the AB 130 moratorium.

F. The Council declares that this emergency ordinance is necessary as an emergency measure to preserve the public peace, health, or safety by ensuring that the City may enforce its local amendments to the California Energy Code during the AB 130 moratorium. These local amendments are necessary to mitigate the public health and safety impacts of GHG emissions from natural gas usage by incentivizing energy efficiency and electrification.

G. Additionally, the Council finds that these changes or modifications to the California Energy Code are necessary to implement a local code amendment that is adopted to align with a general plan approved on or before June 10, 2025, and that permits mixed-fuel residential construction consistent with federal law while also incentivizing all-electric construction as part of an adopted greenhouse gas emissions reduction strategy. The City of Palo Alto's Comprehensive Plan was adopted on November 13, 2017, and amended on December 19, 2022. The relevant policies and goals in the Comprehensive Plan include, but are not limited to: Goal N-7 ("A clean, efficient energy supply that makes use of cost-effective renewable resources") and Goal N-8 ("Actively support regional efforts to reduce our contribution to climate change while adapting to the effects of climate change on land uses and city services") contained in the Natural Environment Element and associated policies and programs. These include Policy N-7.4 ("Maximize the conservation and efficient use of energy in new and existing residences and other buildings in Palo Alto"), Program N-7.4.1 ("Continue timely incorporation of State and federal energy efficiency standards and policies in relevant City codes, regulations and procedures and higher local efficiency standards that are cost-effective"), Policy N-7.7: ("Explore a variety of cost-effective ways to reduce natural gas usage in existing and new buildings in Palo Alto in order to reduce associated greenhouse gas emissions"), and especially Policy N-8.2 ("With guidance from the City's Sustainability and Climate Action Plan (S/CAP) and its subsequent updates and other future planning efforts, reduce greenhouse gas emissions from City operations and from the community").

H. California Health and Safety Code sections 17958.5 and 17958.7 require that the City, in order to make changes or modifications in the requirements contained in the California Building Standards Code on the basis of local conditions, make express finding that such modifications or changes are reasonably necessary because of local climatic, geological or topographical conditions. The required findings are attached to this ordinance as Exhibit A.

SECTION 2. Chapter 16.17 (California Energy Code, California Code of Regulations, Title 24, Part 6) of the Palo Alto Municipal Code is hereby amended by repealing in its entirety existing Chapter 16.17 and adopting a new Chapter 16.17 to read as follows:

CHAPTER 16.17
CALIFORNIA ENERGY CODE,
CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 6

Sections

16.17.010 2025 California Energy Code, Title 24, Part 6 adopted.

The California Energy Code, 2025 Edition, Title 24, Part 6 of the California Code of Regulations together with those omissions, amendments, exceptions and additions thereto, is adopted and hereby incorporated in this Chapter by reference and made a part hereof the same as if fully set forth herein. Except as amended herein, all requirements of the California Energy Code, 2025 Edition, Title 24, Part 6 of the California Code of Regulations shall apply.

Unless superseded and expressly repealed, references in City of Palo Alto forms, documents and regulations to the chapters and sections of the former editions of the California Code of Regulations, Title 24, shall be construed to apply to the corresponding provisions contained within the California Code of Regulations, Title 24, 2025. Ordinance No. 5627 of the City of Palo Alto and all other ordinances or parts of ordinances in conflict herewith are hereby suspended and expressly repealed.

One copy of the California Energy Code, 2025 Edition, has been filed for use and examination of the public in the Office of the Chief Building Official of the City of Palo Alto.

16.17.020 Cross - References to California Energy Code

The provisions of this Chapter contain cross-references to the provisions of the California Energy Code, 2025 Edition, in order to facilitate reference and comparison to those provisions.

16.17.030 Local Amendments

The provisions of this Chapter shall constitute local amendments to the cross-referenced provisions of the California Energy Code, 2025 Edition, and shall be deemed to replace the cross-referenced sections of said Code with the respective provisions set forth in this Chapter.

16.17.040 Administration & Enforcement of 2025 California Energy Code

Administration and enforcement of this code shall be governed by Chapter 1, Division II of the 2025 California Building Code as amended by Palo Alto Municipal Code Chapter 16.04.

16.17.050 Violations - Penalties

It is unlawful for any person to violate any provision or to fail to comply with any of the requirements of this Chapter or any permits, conditions, or variances granted under this Chapter. Violators shall be subject to any penalty or penalties authorized by law, including but not limited to: administrative enforcement pursuant to Chapters 1.12 and 1.16 of the Palo Alto Municipal Code; and criminal enforcement pursuant to Chapter 1.08 of the Palo Alto Municipal Code. Each separate day or any portion thereof during which any violation of this Chapter occurs or continues shall be deemed to constitute a separate offense.

When the chief building official determines that a violation of this Chapter has occurred, the chief building official may record a notice of pendency of code violation with the Office of the County Recorder stating the address and owner of the property involved. When the violation has been corrected, the chief building official shall issue and record a release of the notice of pendency of code violation.

16.17.060 Subchapter 1 All Occupancies – General Provisions

Section 100.0 – SCOPE is amended to add new subsections (i) and (j) as follows:

(i) Single Family Building Remodel Energy Reach Code - Purpose and Intent.

In addition to all requirements of the California Energy Code applicable to Single Family building additions and alterations, the energy efficiency, renewable energy, and electric readiness measures specified in Sections 150.0(w) and 150.0(x) shall be required for

certain single-family additions and alterations.

(j) SUBSTANTIAL REMODEL (or "50-50-50" RULE) Any project that affects the removal or replacement of 50% or more linear length of the existing exterior walls of the building, 50% or more linear length of the existing exterior wall where the plate height is raised, or 50% or more of the existing roof framing area is removed or replaced, over a 3-year period is considered a substantial remodel.

a. Any permit(s) applied for will trigger a review of a 3-year history of the project. This review will result in determining if a substantial remodel has occurred.

b. The Chief Building Official or designee shall make the final determination regarding the application if a conflict occurs.

Section 100.1(b) of Subchapter 1 of the California Energy Code is amended by adding the following definitions:

COVERED SINGLE FAMILY PROJECT shall mean any project in a Single-Family residential building originally permitted for construction before 2011 that meets any of the following criteria:

1. All residential building additions and/or alterations exceeding 1000 square feet, as amended by this Chapter and as applicable to the scope of work.

   For Covered Single Family Projects, the area of alterations will include any construction or renovation to an existing structure other than repair or addition. Alterations include raising the plate height, historic restoration, changes or rearrangements of the structural parts or elements, and changes or rearrangement of bearing walls and full height partitions.

   Normal maintenance, reroofing, painting or wall papering, floor finishes, replacement-in-kind of mechanical, plumbing and electrical systems, or replacing or adding new kitchen counter and similar furniture, plumbing fixture to the building are excluded for the purposes of establishing scope of Covered Single-Family Projects.

   The area of alteration should be limited to the footprint of element(s) being altered.

   The sum of the footprint of the elements being altered with respect to Covered Single Family Projects, shall be calculated using the following methodology:

   1. Raising the plate height: The calculation with respect to raising of the plate height will be based on the area of the footprint in which the plate height is being increased. Plate height means the vertical distance measured from the top of the finished floor to the top of the plates.
   2. Historic restoration: The calculation with respect to historic

restoration will be based on the area of work covered in the California Historical Building Code (Title 24, Part 8).

3. Structural parts or elements: The calculation with respect to changes or rearrangements of the structural parts or elements will be based on the sum of the individual footprints of each structural change or rearrangement. The footprint shall be calculated based on the proposed design and inclusive of any demolished structural parts or elements.
4. Bearing walls and full height partition: The calculation with respect to changes or rearrangement of walls and full height partitions will be based on the footprint of any demolished wall or full height partition and any new wall or new full height partition.

Exception: Attached and detached Accessory Dwelling Units, ADU conversions of existing structures shall meet the California Energy Code Mandatory measures only.

CERTIFIED ENERGY ANALYST is a person registered as a Certified Energy Analyst with the California Association of Building Energy Consultants as of the date of submission of a Certificate of Compliance as required under section 10-103 of Building Energy Efficiency Standards for residential and nonresidential buildings.

ELECTRIC EQUIPMENT OR APPLIANCE means one or more devices that use electric energy to serve the needs for heating and cooling, water heating, cooking, and electric vehicle charging. In addition, ancillary equipment such as an electric panel, photovoltaic equipment, and energy storage systems that are deployed to support such devices shall be considered Electric Equipment or Appliance.

ELECTRIC HEATING APPLIANCE is a device that produces heat energy to create a warm environment by the application of electric power to resistance elements, refrigerant compressors, or dissimilar material junctions, as defined in the California Mechanical Code.

SUBSTANTIAL REMODEL (or "50-50-50" RULE) Any project that affects the removal or replacement of 50% or more linear length of the existing exterior walls of the building, 50% or more linear length of the existing exterior wall where the plate height is raised, or 50% or more of the existing roof framing area is removed or replaced, over a 3-year period is considered a substantial remodel. (Refer to Section 100.0 (j).

16.17.070 Reserved

16.17.080 Reserved

16.17.090 Reserved

16.17.100 Reserved

16.17.110 Reserved

16.17.120 SUBCHAPTER 7 SINGLE-FAMILY RESIDENTIAL BUILDING – MANDATORY FEATURES AND DEVICES

Section 150.0 MANDATORY FEATURES AND DEVICES

Section 150.0 of Subchapter 7 of the California Energy Code is amended to read as follows (additions underlined, deletions ~~struck through~~):

Single-family residential buildings shall comply with the applicable requirements of Sections 150(a) through 150.0(x).

NOTE: The requirements of Sections 150.0 (a) through (v) apply to newly constructed buildings. Sections 150.2(a) and 150.2(b) specify which requirements of Sections 150.0(a) through 150.0(v) also apply to additions or alterations. The electric readiness requirements of Sections 150.0 (n), (t), (u) and (v) apply to residential remodels or additions when the applicable system is included in the remodel. In addition, Covered Single Family Projects shall also be required to comply with Section 150.0(w) and certain additions and alterations shall also be required to comply with Section 150.0(x).

Subsections 150.0 (a) – (s) are adopted without modification.

(t) Heat pump space heater ready. Systems using gas or propane furnace to serve individual dwelling units shall include the following:

1. A dedicated 240 volt branch circuit wiring shall be installed within 3 feet from the furnace and accessible to the furnace with no obstructions. The branch circuit conductors shall be rated at 30 amps minimum. The blank cover shall be identified as "240V ready." All electrical components shall be installed in accordance with the *California Electrical Code*.
2. The main electrical service panel shall have a reserved space to allow for the installation of a double pole circuit breaker for a future heat pump space heater installation. The reserved space shall be permanently marked as "For Future 240V use."
3. A designated exterior location for a future heat pump compressor unit.

Subsections 150.0 (u) – (v) are adopted without modification.

A new Subsection, (w), is added to Section 150.0 as follows:

(w) A Covered Single-Family Project shall install a set of measures based on the building vintage from the Measure Menu Table, Table 150.0-J, to achieve a total Measure Point Score that is equal to or greater than the Target Score in Table 150.0-I. In addition, all mandatory measures listed in Table 150.0-J shall be installed. Measure verification shall be explicitly included as an addendum to the Certificate of Compliance to be filed pursuant to 2025 Title 24, Part 6, Section 10-103.

Installed measures shall meet the specifications in Table 150.0-K. Building vintage is the year in which the original construction permit for the building was submitted, as documented by building department records, or the permit issue date of an addition or alteration that satisfied the Performance Standards (California Energy Code, Title 24, Part 6, Section 150.1(b)) that were in effect at that time. Unless otherwise specified, the requirements shall apply to the entire dwelling unit, not just the additional or altered portion. Measures from the Measure Menu table that are to be installed to satisfy requirements under the California Energy Code, Title 24, Part 6, may not count towards compliance with these requirements. Where these requirements conflict with other California Energy Code requirements, the stricter requirements shall prevail.

Exception 1 to Section 150.0(w): Creation of a new accessory dwelling unit or junior accessory dwelling unit that is within the existing space of a single family dwelling or accessory structure and include an expansion of not more than 150 square feet beyond the same physical dimensions as the existing accessory structure. An expansion beyond the physical dimensions of the existing accessory structure shall be limited to accommodating ingress and egress. Or, if the project would not otherwise be a Covered Single Family Project were it not for the inclusion of an accessory dwelling unit or junior accessory dwelling unit that meets the criteria above.

Exception 2 to Section 150.0(w): Mobile Homes, Manufactured Housing, or Factory-built Housing as defined in Division 13 of the California Health and Safety 12 Code (commencing with Section 17000 of the Health and Safety Code).

Exception 3 to Section 150.0(w): Emergency Housing pursuant to Appendix P of the California Building Code.

Exception 4 to Section 150.0(w): An alteration that consists solely of roof and/or fenestration projects.

Exception 5 to Section 150.0(w): If the project includes circumstances which constitute hardship or infeasibility, the applicant may request an exemption. In applying for an exemption, the burden is on the applicant to show hardship or infeasibility. Circumstances that constitute hardship or infeasibility shall include one or more of the following:

(a) That the cost of achieving compliance exceeds 20% of the valuation of cost of the project;

(b) That it is technically infeasible to achieve compliance through all packages due to conditions specific to the project;

(c) That strict compliance with these standards would create or maintain a hazardous condition(s) and present a life safety risk to the occupants.

Applicants shall follow the Infeasibility procedures in PAMC 16.17.170.

Exception 6 to Section 150.0(w): If the applicant demonstrates, using Commission-certified compliance software as specified by Section 10-109(c) and Section 10-116, that the Energy Budget of the Proposed Building Design would be less than or equal to the Energy Budget of the building under the project if it included any set of measures that would achieve compliance under this Section 150.0(w).

Certificate of Compliance. The Certificate of Compliance shall be prepared and signed by a Certified Energy Analyst and the energy budget for the Proposed Design shall be no greater than the Standard Design Building.

Exception 7 to Section 150.0(w): If the dwelling unit has previously installed measures from the Measure Menu, Table 150.0-J, and compliance can be demonstrated to the building official, then these measures shall not be required to be newly installed, and appropriate credit shall be included in the applicable compliance calculations.

Exception 8 to Section 150.0(w): A measure that is necessary for compliance is prohibited because of a covenant or other deed restriction on the property, such as a homeowners association covenant.

Exception 9 to Section 150.0(w): A Covered Single-Family Project, other than an addition, that would not otherwise be subject to this section 150.0(w) but for installation of solar PV, solar water heating, EV charging, electrical upgrades for solar PV or EV charging, or energy storage.

Exception 10 to Section 150.0(w): The project is solely related to a repair, as defined by Title 24 Part 2 Section 202.

Exception 11 to Section 150.0(w) and 150.0(x): A Covered Single Family Project that consists solely of medically necessary improvements or solely of seismic safety improvements.

TABLE 150.0-I: TARGET SCORES

Building Vintage	Pre-1978	1978-1991	1992-2010
Climate Zone 4	12	12	12

TABLE 150.0-J: MEASURE MENU, CLIMATE ZONE 4

ID	Measures	Building Vintage		
		Pre-1978	1978-1991	1992-2010
E1	Lighting Measures	Mandatory		
E2	Water Heating Package	1	1	1
E3	Air Sealing	2	1	1
E4.A	R-38 Attic Insulation	7	3	1
E4.B	R-49 Attic Insulation	7	3	1
E5	Duct Sealing	6	4	1
E6.A	New Ducts, R-6 Insulation + Duct Sealing	10	7	2
E6.B	New Ducts, R-8 Insulation + Duct Sealing	11	8	3
E7	Windows	6	5	3
E8	R-15 Wall Insulation	6	--	--
E10.A	R-19 Raised floor insulation	8	8	--
E10.B	R-30 Raised floor insulation	9	9	--
E11	Radiant Barrier Under Roof (when re-roofing)	3	2	1
FS1	Heat Pump Water Heater Replacing Gas	12	12	12
FS2	High Eff. Heat Pump Water Heater Replacing Gas	13	13	13
FS3	Heat Pump Water Heater Replacing Electric	4	4	4
FS4	High Eff. Heat Pump Water Heater Replacing Electric	5	5	5

FS5	Heat Pump Space Conditioning System	21	16	13
FS6	High Eff. Heat Pump Space Conditioning System	23	18	15
FS7	Dual Fuel Heat Pump Space Conditioning System	15	11	10
FS8	Heat Pump Clothes Dryer	1	1	1
FS9	Induction Cooktop	1	1	1
PV	Solar PV	17	17	15

TABLE 150.0-K: MEASURE SPECIFICATIONS

ID	Measure Specification
	Energy Efficiency Measures
E1	Lighting Measures – Install lighting with an efficiency of 45 lumens per watt or greater in all interior and exterior screw-in fixtures. Install photocell, occupancy sensor or energy management system controls that meet the requirements of 150.0(k)3 in all outdoor lighting permanently mounted to a residential building or to other buildings on the same lot.
E2	Water Heating Package: Insulate all accessible hot water pipes with pipe insulation a minimum of ¾ inch thick. This includes insulating the supply pipe leaving the water heater, piping to faucets underneath sinks, and accessible pipes in attic spaces or crawlspaces. Upgrade fittings in sinks and showers to meet current California Green Building Standards Code (Title 24, Part 11) Section 4.303 water efficiency requirements. Exception: Upgraded fixtures are not required if existing fixtures have rated or measured flow rates of no more than ten percent greater than 2025 California Green Building Standards Code (Title 24, Part 11) Section 4.303 water efficiency requirements.
E3	Air Sealing: Seal all accessible cracks, holes, and gaps in the building envelope at walls, floors, and ceilings. Pay special attention to penetrations including plumbing, electrical, and mechanical vents, recessed can light luminaires, and windows. Weather-strip doors if not already present. Verification shall be conducted following a prescriptive checklist that outlines which building aspects need to be addressed by the permit applicant and verified by an inspector. Compliance can also be demonstrated with blower door testing conducted by a certified ECC Rater no more than three years prior to the permit application date that either: a) shows at least a 30 percent reduction from pre-retrofit conditions; or b) shows that the number of air changes per hour at 50 Pascals pressure difference (ACH50) does not exceed ten for Pre-1978 vintage buildings, seven for 1978 to 1991 vintage buildings and five for 1992-2010 vintage buildings. If combustion appliances are located within the pressure boundary of the building, conduct a combustion safety test by a certified ECC Rater or a professional certified by the Building Performance Institute, in accordance with the BPI Technical Standards for the Building Analyst Professional.
E4.A	R-38 Attic Insulation: Attic insulation shall be installed to achieve a weighted assembly U-factor of 0.025 or insulation installed at the ceiling level shall have a thermal resistance of R-38 or greater for the insulation alone. Recessed downlight luminaires in the ceiling shall be covered with insulation to the same depth as the rest of the ceiling. Luminaires not rated for insulation contact must be replaced or fitted with a fire-proof cover that allows for insulation to be installed directly over the cover.

	Exception: In buildings where existing R-30 is present and existing recessed downlight luminaires are not rated for insulation contact, insulation is not required to be installed over the luminaires.
E4.B	R-49 Attic Insulation: Attic insulation shall be installed to achieve a weighted assembly U-factor of 0.020 or insulation installed at the ceiling level shall have a thermal resistance of R-49 or greater for the insulation alone. Recessed downlight luminaires in the ceiling shall be covered with insulation to the same depth as the rest of the ceiling. Luminaires not rated for insulation contact must be replaced or fitted with a fire-proof cover that allows for insulation to be installed directly over the cover. Exception: In buildings where existing R-30 is present and existing recessed downlight luminaires are not rated for insulation contact, insulation is not required to be installed over the luminaires.
E5	Duct Sealing: Air seal all space conditioning ductwork to meet the requirements of the 2025 Title 24, Part 6, Section 150.2(b)1E. The duct system must be tested by a ECC Rater no more than three years prior to the Covered Single Family Project permit application date to verify the duct sealing and confirm that the requirements have been met. This measure may not be combined with the New Ducts and Duct Sealing measure in this Table. Exception: Buildings without ductwork or where the ducts are in conditioned space.
E6.A	New Ducts, R-6 insulation + Duct Sealing: Replace existing space conditioning ductwork with new R-6 ducts that meet the requirements of 2025 Title 24 Section 150.0(m)11. This measure may not be combined with the Duct Sealing measure in this Table. To qualify, a preexisting measure must have been installed no more than three years before the Covered Single Family Project permit application date.
E6.B	New Ducts, R-8 insulation + Duct Sealing: Replace existing space conditioning ductwork with new R-8 ducts that meet the requirements of 2025 Title 24 Section 150.0(m)11. This measure may not be combined with the Duct Sealing measure in this Table. To qualify, a preexisting measure must have been installed no more than three years before the Covered Single Family Project permit application date.
E7	Windows: Replace at least 50% of existing windows with high performance windows with an area-weighted average U-factor no greater than 0.27 in Climate Zones 4.
E8	R-15 Wall Insulation: Install wall insulation in all exterior walls to achieve a weighted U-factor of 0.095 or install wall insulation in all exterior wall cavities that shall result in an installed thermal resistance of R-15 or greater for the insulation alone.
E9	Reserved for future use
E10.A	R-19 Floor Insulation: Raised-floors shall be insulated such that the floor assembly has an assembly U-factor equal to or less than U-0.037 or shall be insulated between wood framing with insulation having an R-value equal to or greater than R-19.
E10.B	R-30 Floor Insulation: Raised-floors shall be insulated such that the floor assembly has an assembly U-factor equal to or less than U-0.028 or shall be insulated between wood framing with insulation having an R-value equal to or greater than R-30.
E11	Radiant Barrier: A radiant barrier that meets the requirements of Section 150.1(c)2 shall be installed under at least 50% of the roof surface.
	Fuel Substitution and Solar PV Measures
FS1	Heat Pump Water Heater (HPWH) Replacing Gas: Replace existing natural gas water heater with a heat pump water heater that meets the requirements of Sections 110.3 and 150.2(b)1.H.iii.b.

FS2	High Efficiency Heat Pump Water Heater (HPWH) Replacing Gas: Replace existing natural gas water heater with heat pump water heater with a Northwest Energy Efficiency Alliance (NEEA) Tier 3 or higher rating that also meets the requirements of Sections 110.3 and 150.2(b)1.H.iii.c.
FS3	Heat Pump Water Heater (HPWH) Replacing Electric: Replace existing electric resistance water heater with a heat pump water heater that meets the requirements of Sections 110.3 and 150.2(b)1.H.iii.b.
FS4	High Efficiency Heat Pump Water Heater (HPWH) Replacing Electric: Replace existing electric resistance water heater with heat pump water heater with a Northwest Energy Efficiency Alliance (NEEA) Tier 3 or higher rating that also meets the requirements of Sections 110.3, and 150.2(b)1.H.iii.c.
FS5	Heat Pump Space Conditioning System: Replace all existing gas and electric resistance primary space heating systems with a heat pump system that meets the requirements of Sections 110.3, 150.2(b)1.C, 150.2(b)1.E, 150.2(b)1.F, and 150.2(b)1.G.
FS6	High Efficiency Heat Pump Space Conditioning System: Replace all existing gas and electric resistance primary space heating systems with an electric-only heat pump system that meets the requirements of Sections 110.3 and 150.2(b)1.C, 150.2(b)1.E, 150.2(b)1.F, and 150.2(b)1.G and one of the following: A. A ducted heat pump system with a SEER2 rating of 16.5 or greater, an EER2 rating of 12.48 or greater and an HSPF2 rating of 9.5 or greater; or B. A ductless mini-split heat pump system with a SEER2 rating of 14.3 or greater, an EER2 rating of 11.7 or greater and an HSPF2 rating of 7.5 or greater
FS7	Dual Fuel Heat Pump Space Conditioning System: Install a heat pump space conditioning system that meets the requirements of Sections 110.3 and 150.2(b)1.C, 150.2(b)1.E, 150.2(b)1.F, and 150.2(b)1.G and either: A. Replaces all existing gas and electric resistance primary heating systems with a hybrid gas and electric heat pump system, or B. Is an electric-heat pump system in tandem with a gas furnace and controls to use the gas furnace for backup heat only.
FS8	Heat Pump Clothes Dryer: Replace existing electric resistance or gas clothes dryer with heat pump dryer with no resistance element and cap gas line.
FS9	Induction Cooktop: Replace all existing gas and electric resistance stove tops with inductive stove top and cap the gas line.
PV.A	Solar PV: Install a solar PV system that meets the requirements of Section 150.1(c)14.

A new Subsection, (x), is added to Section 150.0 as follows:

(x) Electric Readiness for Alterations

1. Electric range. Where branch circuits or receptacles are added or altered in a kitchen and the work requires a building permit, install electrical components in accordance with the California Electrical Code. The electrical components shall include either of the following:
   A. A 125 volt, 20 amp electrical receptacle that is connected to the electric panel with a 120/240 volt 3 conductor branch circuit rated at 50 amps minimum, within 3 feet from the appliance and accessible to the appliance with no obstructions. Both ends of the unused conductor shall be

labeled with the word “spare” and be electrically isolated. Space shall be reserved for a single pole circuit breaker in the electrical panel adjacent to the circuit breaker for the branch circuit and labeled with the words “Future Use”.

B. A pathway for a future 240 volt 50 amp minimum branch circuit that shall consist of either conductors or raceway from the main electrical service panel. The main electric panel shall have space reserved to allow for the installation of a double pole circuit breaker for a future electric range installation. The reserved space shall be permanently marked as “For Future 240V use”. The raceway or conductors shall terminate at a junction box within 3 feet of the appliance. The blank cover shall be identified as “240V ready”.

2. Electric dryer. Where a branch circuit is added or altered within 3 feet of a gas or propane clothes dryer and the work requires a building permit, install electrical components in accordance with the California Electrical Code. The electrical components shall include either of the following:

A. A dedicated 125 volt, 20 amp electrical receptacle that is connected to the electric panel with a 120/240 volt 3 conductor branch circuit rated at 30 amps minimum, within 3 feet from the appliance and accessible to the appliance with no obstructions. Both ends of the unused conductor shall be labeled with the word “spare” and be electrically isolated. Space shall be reserved for a single pole circuit breaker in the electrical panel adjacent to the circuit breaker for the branch circuit and labeled with the words “Future Use”; or,

B. A pathway for a future 240 volt 30 amp minimum branch circuit that shall consist of either conductors or raceway from the main electrical service panel. The main electric panel shall have space reserved to allow for the installation of a double pole circuit breaker for a future heat pump dryer installation. The reserved space shall be permanently marked as “For Future 240V use”. The raceway or conductors shall terminate at a junction box within 3 feet of the appliance. The blank cover shall be identified as “240V ready”.

3. Heat pump water heater.

A. If wall framing is removed or replaced within 3 feet of a gas or propane water heating appliance, space suitable for the future installation of a heat pump water heater (HPWH) shall be provided. The space shall be at least 2.5 feet by 2.5 feet wide and 7 feet tall and shall include a condensate drain that is no more than 2 inches higher than the base of an installed water heater and allows natural draining without pump assistance or installed piping or tubing within 3 feet of the water heater

location to a condensate drain or exterior location. If pump assistance is needed, a receptacle on a 120 volt, minimum 15 amp branch circuit for a condensate pump must be available within 3 feet of the water heater location.

B. Where branch circuits are altered or added within 3 feet of an existing gas or propane water heater or within 10 feet of the designated future location of a heat pump water heater as required under Section 150.0(x)3A, and the work requires a building permit, install electrical components in accordance with the California Electrical Code. The electrical components shall include either of the following:
   i. A dedicated 125 volt, 20 amp electrical receptacle that is connected to the electric panel with a 120/240 volt 3 conductor, 10 AWG copper branch circuit rated at 30 amps minimum, within 3 feet from the water heater and accessible to the water heater with no obstructions. Both ends of the unused conductor shall be labeled with the word "spare" and be electrically isolated. Space shall be reserved for a single pole circuit breaker space in the electrical panel adjacent to the circuit breaker for the branch circuit and labeled with the words "Future 240V Use"; or
   ii. A pathway for a future 240 volt 30 amp minimum branch circuit that shall consist of either conductors or raceway from the main electrical service panel. The main electric panel shall have space reserved to allow for the installation of a double pole circuit breaker for a future HPWH installation. The reserved space shall be permanently marked as "For Future 240V use". The pathway shall terminate at a junction box within 3 feet of the appliance. The blank cover shall be identified as "240V ready".

Exception 1 to Section 150.0(x): The project is the result of a repair as defined by Title 24 Part 2 Section 202.

Exception 2 to Section 150.0(x): If a building permit, is not otherwise required for the project other than compliance with this section.

Exception 4 to Section 150.0(x): The project is the result of a safety improvement to remove a known hazard.

Exception 5 to Section 150.0(x): Mobile Homes, Manufactured Housing, or Factory-built Housing as defined in Division 13 of the

California Health and Safety 12 Code (commencing with Section 17000 of the Health and Safety Code).

Exception 6 to Section 150.0(x): Emergency Housing pursuant to Appendix P of the California Building Code.

Exception 7 to Section 150.0(x): Creation of a new accessory dwelling unit or junior accessory dwelling unit that is within the existing space of a single family dwelling or accessory structure and includes an expansion of not more than 150 square feet beyond the same physical dimensions as the existing accessory structure. An expansion beyond the physical dimensions of the existing accessory structure shall be limited to accommodating ingress and egress. Or, if the project would not otherwise be a Covered Single Family Project were it not for the inclusion of an accessory dwelling unit or junior accessory dwelling unit that meets the criteria above.

16.17.130 Reserved

16.17.140 SUBCHAPTER 9 SINGLE-FAMILY RESIDENTIAL BUILDINGS—ADDITIONS AND ALTERATIONS TO EXISTING RESIDENTIAL BUILDINGS

The requirements of PAMC 16.17.140 shall apply to building permit applications submitted to the City on or after January 1, 2027 and shall apply to all building permit applications submitted to the City on or after that date.

Section 150.2 – ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS TO EXISTING SINGLE-FAMILY RESIDENTIAL BUILDINGS – of Subchapter 9 of the 2025 California Energy Code is adopted without amendment, except as follows (additions underlined, deletions ~~struck through~~):

Section 150.2(b)1C is hereby amended to read:

C. **Entirely new or complete replacement space-conditioning systems** installed as part of an alteration, shall include all the system heating or cooling equipment, including but not limited to: condensing unit cooling or heating coil, and air handler for split systems; or complete replacement of a packaged unit; plus entirely new or replacement duct system (Section 150.2(b)1Diia). Entirely new or complete replacement space-conditioning systems shall meet the requirements of Sections 150.0(h), 150.0(i), 150.0(j)1, 150.0(j)2, 150.0(m)1 through 150.0(m)10; 150.0(m)12; 150.0(m)13, 150.1(c)7, ~~150.2(b)1Fii,~~ 150.2(b)1G, and TABLE 150.2-A. Additionally, where an entirely new or complete replacement space conditioning system includes a new or replacement air-cooled air conditioner in Climate Zones 1 through 14 and 16,

it shall meet the applicable requirements of Section 150.2(b)1Fiv. Where an entirely new or complete replacement space conditioning system includes a new or replacement heat pump, it shall meet the applicable requirements of Section 150.2(b)1Fv.

Section 150.2(b)1.F. is hereby amended to read:

F. **Altered space-conditioning system - mechanical cooling.** Alterations which install new or replacement air-cooled air conditioners shall meet the applicable requirements of subsections i and iv. Alterations which install new or replacement heat pumps shall meet the applicable requirements of subsections i, ii, iii, and v. All other alterations to refrigerant containing components such as the compressor, condensing coil, evaporator coil, refrigerant metering device, or refrigerant piping, shall meet the applicable requirements of subsections i, ii, and iii. ~~When a space-conditioning system is an air-conditioner or heat pump that is altered by the installation or replacement of refrigerant-containing system components such as the compressor, condensing coil, evaporator coil, refrigerant metering device or refrigerant piping, the altered system shall comply with the following requirements:~~

i. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c).

ii. Air-cooled air conditioners in Climate Zones 2 and 8 through 15 and air-source heat pumps in all climate zones, including but not limited to ducted split systems, ducted package systems, small duct high velocity air systems, and minisplit systems, shall comply with Subsections a and b, unless the system is of a type that cannot be verified using the specified procedures. Systems that cannot comply with the requirements of 150.2(b)1Fii shall comply with Section 150.2(b)1Fiii.

Exception to Section 150.2(b)1Fii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiia, provided that the system is of a type that can be verified using the procedure specified in RA3.3 or an approved alternative in RA1.

a. Minimum system airflow rate shall comply with the applicable Subsection I or II below as confirmed through field verification and diagnostic testing in accordance with the procedures specified in Reference Residential Appendix Section RA3.3 or an approved

alternative procedure as specified in Section RA1.

I. Small duct high velocity systems shall demonstrate a minimum system airflow rate greater than or equal to 250 cfm per ton of nominal cooling capacity; or

II. All other air-cooled air conditioner or air-source heat pump systems shall demonstrate a minimum system airflow rate greater than or equal to 300 cfm per ton of nominal cooling capacity; and

Exception 1 to Section 150.2(b)1Fiia: Systems unable to comply with the minimum airflow rate requirement shall demonstrate compliance using the procedures in Section RA3.3.3.1.5; and the system's thermostat shall conform to the specifications in Section 110.12.

Exception 2 to Section 150.2(b)1Fiia: Entirely new or complete replacement space conditioning systems, as specified by Section 150.2(b)1C, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in Tables-150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in Tables150.0-B and 150.0-C.

b. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable.

I. The installer and rater shall perform the standard charge verification procedure as specified in Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified in Section RA1; or

II. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The ECC-Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1.

Exception 1 to Section 150.2(b)1Fiib: When the outdoor temperature is less than 55° F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1to demonstrate compliance, the installer may elect to utilize the verification procedure in Reference Residential

Appendix Section RA3.2.3.2. If the verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Section 110.12. Ducted systems shall comply with the minimum system airflow rate requirements in Section 150.2(b)1Fiia.

iii. Air-cooled air conditioners in Climate Zones 2 and 8 through 15 and air-source heat pumps in all climate zones, including but not limited to ducted split systems, ducted package systems, small duct high velocity, and minisplit systems, which are of a type that cannot comply with the requirements of 150.2(b)1Fiib shall comply with subsections a and b, as applicable.

a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by an ECC-Rater according to the procedures specified in Reference Residential Appendix RA3.2.3.2; and

b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.2(b)1Fiia provided the system is of a type that can be verified using the procedures in Section RA3.3 or an approved alternative procedure in Section RA1.

Exception to Section 150.2(b)1Fiii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiiib, provided that the system is of a type that can be verified using the procedure specified in Section RA3.3 or an approved alternative in Section RA1.

iv. <u>New or replacement air-cooled air conditioners in Climate Zones 1 through 14 and 16 shall meet the requirements of Section 150.2(b)1Fiva or 150.2(b)1Fivb.</u>

<u>a. Systems with existing duct distribution systems shall meet the following requirements:</u>

<u>I. In all climate zones, meet the airflow and fan efficacy requirements of Section 150.0(m)13B, 150.0(m)13C, or 150.0(m)13D.</u>

Exception 1 to Section 150.2(b)1Fival: Single zone central forced air systems and zonally controlled central forced air systems may demonstrate compliance with an airflow greater than or equal to 300 CFM per ton of nominal cooling capacity.

II. In all climate zones, meet the refrigerant charge verification requirements of Section 150.2(b)1Fii; and

III. In all climate zones, vented attics shall have insulation installed to achieve a U-factor of 0.020 or insulation installed at the ceiling level shall result in an insulated thermal resistance of R-49 or greater for the insulation alone; luminaires not rated for insulation contact must be replaced or retrofitted with a fireproof cover that allows for insulation to be installed directly over the cover; and

Exception 1 to Section 150.2(b)1FivaIII: Dwelling units with at least R-38 existing insulation installed at the ceiling level.

Exception 2 to Section 150.2(b)1FivaIII: Dwelling units where the alteration would directly cause the disturbance of asbestos unless the alteration is made in conjunction with asbestos abatement.

Exception 3 to Section 150.2(b)1FivaIII: Dwelling units with knob and tube wiring located in the vented attic.

Exception 4 to Section 150.2(b)1FivaIII: Where the accessible space in the attic is not large enough to accommodate the required R-value, the entire accessible space shall be filled with insulation provided such installation does not violate Section 806.3 of Title 24, Part 2.5.

Exception 5 to Section 150.2(b)1FivaIII: Where the attic space above the altered dwelling unit is shared with other dwelling units and the requirements of Section 150.2(b)1FivaIII are not triggered for the other dwelling units.

IV. In all climate zones, air seal all accessible areas of the ceiling plane between the attic and the conditioned space in accordance with Section 110.7.

Exception 1 to Section 150.2(b)1FivaIV: Dwelling units with at least R-38 existing insulation installed at the ceiling level.

Exception 2 to Section 150.2(b)1FivaIV: Dwelling units where the alteration would directly cause the disturbance of asbestos unless the alteration is made in conjunction with asbestos abatement.

Exception 3 to Section 150.2(b)1FivaIV: Dwelling units with atmospherically vented space heating or water heating

combustion appliances located inside the pressure boundary of the dwelling unit.

b. Systems with entirely new or complete replacement duct systems shall meet the following:

I. R-8 duct insulation shall be installed for all new ducts located in unconditioned space; and

II. In all climate zones, meet the airflow requirements of Section 150.0(m)13B, 150.0(m)13C, or 150.0(m)13D and demonstrate an air-handling unit fan efficacy of less than or equal to 0.35 W/CFM.

III. In all climate zones, meet the refrigerant charge verification requirements of Section 150.2(b)1Fii;

Exception 1 to Section 150.2(b)1Fiv: Where the capacity of the existing main electrical service panel is insufficient to supply the electrical capacity of a heat pump and where the existing main electrical service panel is sufficient to supply a new or replacement air conditioner, as calculated according to the requirements of California Electrical Code Article 220.83 or Article 220.87, systems shall comply with the applicable requirements of Sections 150.2(b)1Fi, 150.2(b)1Fii, and 150.2(b)1Fiii. Documentation of electrical load calculations in accordance with Article 220 must be submitted to the enforcement agency prior to permitting for both the heat pump and proposed air conditioner.

Exception 2 to Section 150.2(b)1Fiv: Where the required capacity of a heat pump to meet the system selection requirements of Section 150.0(h)5 is greater than or equal to 12,000 Btu/h more than the greater of the required capacity of an air conditioner to meet the design cooling load OR the capacity of the existing air conditioner, systems shall comply with the applicable requirements of Sections 150.2(b)1Fi, 150.2(b)1Fii, and 150.2(b)1Fiii. Documentation of heating and cooling load calculations in accordance with 150.0(h) must be submitted to the enforcement agency prior to permitting for both the heat pump and proposed air conditioner.

v. In all climate zones, heat pumps with supplementary heat, including, but not limited to, electric resistance heaters or gas furnace supplementary heating, shall comply with Section 150.0(h)7 and shall lock out supplementary heating above an outdoor air temperature of no greater than 35°F.

Section 150.2(b)2 is hereby amended to read:

2. Performance approach.

The energy budget for alterations is expressed in terms of Long-term System Cost (LSC), and the altered component(s) and any newly installed

equipment serving the alteration shall meet the applicable requirements of Subsections A, B, and C below.

A. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (l), Sections 150.0(m)1 through 150.0 (m)10, and Sections 150.0(p) through (q). Entirely new or complete replacement mechanical ventilation systems as these terms are used in Section 150.2(b)1L, shall comply with the requirements in Section 150.2(b)1L. Altered mechanical ventilation systems shall comply with the requirements of Section 150.2(b)1M. Entirely new or complete replacement space-conditioning systems, and entirely new or complete replacement duct systems, as these terms are used in Sections 150.2(b)1C and 150.2(b)1Diia, shall comply with the requirements of Sections 150.0(m)12 and 150.0(m)13. New or replacement air-cooled air conditioners in Climate Zones 1 through 14 and 16 shall meet the applicable requirements of Section 150.2(b)1Fiv.

B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in Table 150.2-G. For components not being altered, the standard design shall be based on the existing conditions. When the third party verification option is specified as a requirement, all components proposed for alteration for which the additional credit is taken, must be verified by a certified ECC-rater.

Table 150.2-G is hereby amended to read:

Table 150.2-G Standard Design for an Altered Component

Altered Component	Standard Design Without Third Party Verification of Existing Conditions Shall be Based On	Standard Design With Third Party Verification of Existing Conditions Shall be Based On
Ceiling Insulation, Wall Insulation, and Raised-floor Insulation	The requirements of Sections 150.0(a), (c), and (d). The requirements of Section 150.2(b)1J for altered ceilings and for entirely new or complete replacement duct systems where the air handler and ducts are located within a vented attic. The requirements of Section 150.2(b)1Fiv for alterations which include new or replacement air-cooled air conditioners.	The existing insulation R-value
Fenestration	The requirements of Section 150.1(c)3A.	The existing fenestration U-factor

		and SHGC values as verified.
Window Film	The requirements of Section 150.1(c)3A.	The existing fenestration in the alteration shall be based on TABLE 110.6-A and TABLE 110.6-B.
Doors	The U-factor of 0.20. The door area shall be the door area of the existing building.	If the proposed U-factor is < 0.20, the standard design shall be based on the existing U-factor value as verified. Otherwise, the standard design shall be based on the U-factor of 0.20. The door area shall be the door area of the existing building.
Space-Heating and Space-Cooling Equipment	Table 150.1-A for equipment efficiency requirements; Section 150.2(b)1C for entirely new or complete replacement systems; Section 150.2(b)1F for refrigerant charge verification, airflow, and fan efficacy requirements. Section 150.2(b)1Fiv for new or replacement air-cooled air conditioners	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Sections 150.2(b)1D and 150.2(b)1E	The requirements of Sections 150.2(b)1D and 150.2(b)1E
Air Distribution System – Duct Insulation	~~The proposed efficiency levels.~~ The requirements of Sections 150.2(b)1D, and for new or replacement air-cooled air conditioners, Section 150.2(b)1Fiv.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.2(b)1Hii	The existing efficiency level.
Roofing Products	The requirements of Section 150.2(b)1I.	The requirements of Section 150.2(b)1I

All Other Measures	The proposed efficiency levels.	The existing efficiency levels.

C. The proposed design shall be based on the actual values of the altered components.

16.17.150 Reserved

16.17.160 Reserved

16.17.170 Infeasibility Exemption.

(a) **Exemption.** If an applicant for a Covered Project believes that circumstances exist that makes it infeasible to meet the requirements of this Chapter, the applicant may request an exemption as set forth below. In applying for an exemption, the burden is on the Applicant to show infeasibility.

(b) **Application.** If an applicant for a Covered Project believes such circumstances exist, the applicant may apply for an exemption at the time of application submittal in accordance with the Planning and Development Services administrative guidelines. The applicant shall indicate the maximum threshold of compliance the energy compliance design professional believes is feasible for the covered project and the circumstances that make it infeasible to fully comply with this Chapter. Circumstances that constitute infeasibility include, but are not limited to the following:

(1) There is conflict with the compatibility of the currently adopted California Building Standards Code;

(2) There is a lack of commercially available materials and technologies to comply with the requirements of this Chapter;

(3) Applying the requirements of this Chapter would effectuate an unconstitutional taking of property or otherwise have an unconstitutional application to the property.

(c) **Granting of Exemption.** If the Director of Planning and Development Services, or designee, determines that it is infeasible for the applicant to fully meet the requirements of this Chapter based on the information provided, the Director, or designee, shall determine the maximum feasible threshold of compliance reasonably achievable for the project. The decision of the Director, or designee, shall be provided to the applicant in writing. If an exemption is granted, the applicant shall be required to comply with this Chapter in all other respects and shall be required to

achieve, in accordance with this Chapter, the threshold of compliance determined to be achievable by the Director or designee.

(d) **Denial of Exemption.** If the Director of Planning and Development Services or designee determines that it is reasonably possible for the applicant to fully meet the requirements of this Chapter, the request shall be denied, and the Director or designee shall so notify the applicant in writing. The project and compliance documentation shall be modified to comply with this Chapter prior to further review of any pending planning or building application.

(e) **Council Review of Exemption.** For any covered project that requires review and action by the City Council, the Council shall act to grant or deny the exemption, based on the criteria outlined above, after recommendation by the Director of Planning and Development Services.

16.17.180 Appeal.

(a) Any aggrieved Applicant may appeal the determination of the Director of Planning and Development Services or designee regarding the granting or denial of an exemption pursuant to 16.17.170.

(b) Any appeal must be filed in writing with the Planning and Development Services Department not later than fourteen (14) days after the date of the determination by the Director. The appeal shall state the alleged error or reason for the appeal.

(c) The appeal shall be processed and considered by the City Council in accordance with the provisions of Section 18.77.070 (f) of the City of Palo Alto Municipal Code.

SECTION 3. The Council adopts the findings for local amendments to the California Energy Code, 2025 Edition, attached hereto as Exhibit "A" and incorporated herein by reference.

SECTION 4. Under the authority granted by Public Resources Code Section 25402.1(h)(2), which permits local California Energy Code amendments, and based on staff's analysis of the "2022 Cost-Effectiveness Study: Existing Single Family Building Upgrades ," "2025 Cost-Effectiveness Study: Single Family AC to Heat Pump Replacement," and "Application of the 2022 Studies to the 2025 Energy Code: Existing Single Family Building Upgrades" developed for the California Energy Codes and Standards Program and attached to staff's report to Council, the Council finds that the proposed local amendments to the 2025 California Energy Code that affect building energy performance are cost-effective and will require buildings to be designed to consume less energy than permitted by Title 24, Part 6.

SECTION 5. If any section, subsection, clause or phrase of this Ordinance is for any reason held to be invalid, such decision shall not affect the validity of the remaining portion or sections of the Ordinance. The Council hereby declares that it should have adopted the Ordinance

and each section, subsection, sentence, clause or phrase thereof irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared invalid.

SECTION 6. The Council finds that this ordinance is exempt from the provisions of the California Environmental Quality Act ("CEQA"), under Section 15308 of the CEQA Guidelines, because it is a regulatory action for the protection of the environment, and under Section 15061(b)(3) on the grounds that the proposed standards are more stringent than the State energy standards, there are no reasonably foreseeable adverse environmental impacts and there is no possibility that the activity in question may have a significant effect on the environment.

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SECTION 7. Pursuant to Palo Alto Municipal Code Section 2.04.270, this ordinance shall be effective immediately upon adoption if passed by a vote of four-fifths of the council members present. Unless otherwise specified in this ordinance, its provisions shall become applicable 180 days after publication of the 2025 Edition of California Energy Code, Title 24, Part 6. Until that date, the provisions of the 2022 Edition of the California Energy Code, as adopted and amended by Ordinance 5627, shall apply and remain in effect.

INTRODUCED:

PASSED:

AYES:

NOES:

ABSENT:

ABSTENTIONS:

ATTEST:

_____
City Clerk

_____
Mayor

APPROVED AS TO FORM:

APPROVED:

_____
City Attorney or Designee

_____
City Manager

_____
Director of Planning and
Development Services

_____
Director of Administrative Services

Exhibit A
FINDINGS FOR LOCAL AMENDMENTS TO CALIFORNIA ENERGY CODE, 2025 EDITION
TITLE 24, PART 6

Section 17958 of the California Health and Safety Code provides that the City may make changes to the provisions of the California Building Standards Code. Sections 17958.5 and 17958.7 of the Health and Safety Code require that for each proposed local change to those provisions of the California Building Standards Code which regulate buildings used for human habitation, the City Council must make findings supporting its determination that each such local change is reasonably necessary because of local climatic, geological, or topographical conditions.

Regarding the Energy Code, local jurisdictions have the authority to adopt local energy efficiency ordinances—or reach codes—that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards), provided the City Council finds that the requirements of the proposed ordinance are cost-effective and do not result in buildings consuming more energy than is permitted by Title 24.

Local building regulations having the effect of amending the uniform codes, which were adopted by the City prior to November 23, 1970, were unaffected by the regulations of Sections 17958, 17958.5 and 17958.7 of the Health and Safety Code. Therefore, amendments to the uniform codes which were adopted by the City Council prior to November 23, 1970 and have been carried through from year to year without significant change, need no required findings. Also, amendments to provisions not regulating buildings used for human habitation do not require findings.

Code: California Energy Code, Title 24, Part 6					
Chapter(s), Sections(s), Appendices	**Title**	**Add**	**Deleted**	**Amended**	**Justification (See below of keys)**
100.0	Scope			✓	**C & E**
100.1(b)	Definitions			✓	**C & E**
150.0	Mandatory Features and Devices			✓	**C & E**
150.2(b)	Energy Efficiency Standards for Additions and Alterations to Existing Single-Family Residential Buildings - Alterations			✓	**C & E**
Table 150.2-G	Standard Design for an Altered Component			✓	**C & E**

	Infeasibility Exemption	✓			**A**
	Appeal	✓			**A**

Key to Justification for Amendments to Title 24 of the California Code of Regulations

A This is an **administrative** amendment to clarify and establish civil and administrative procedures, regulations, or rules to enforce and administer the activities by the Palo Alto Building Inspection Department. These administrative amendments do not need to meet HSC 18941.5/17958/13869 per HSC 18909(c).

C This amendment is justified on the basis of a local **climatic** condition. The seasonal climatic conditions during the late summer and fall create severe fire hazards to the public health and welfare in the City. The hot, dry weather frequently results in wild land fires on the brush covered slopes west of Interstate 280. The aforementioned conditions combined with the geological characteristics of the hills within the City create hazardous conditions for which departure from California Energy Code is required. Failure to address and significantly reduce greenhouse gas (GHG) emissions could result in rises in sea level, including in San Francisco Bay, that could put at risk Palo Alto homes and businesses, public facilities, and Highway 101 (Bayshore Freeway), particularly the mapped Flood Hazard areas of the City. Energy efficiency is a key component in reducing GHG emissions, and the construction of more energy efficient buildings can help Palo Alto reduce its share of the GHG emissions that contribute to climate change. The burning of fossil fuels used in the generation of electric power and heating of buildings contributes to climate change, which could result in rises in sea level, including in San Francisco Bay, that could put at risk Palo Alto homes and businesses 1 public facilities, and Highway 101. Due to a decrease in annual rainfall, Palo Alto experiences the effect of drought and water saving more than some other communities in California.

E Energy efficiency enhances the public health and welfare by promoting the **environmental** and economic health of the City through the design, construction, maintenance, operation, and deconstruction of buildings and sites by incorporating green practices into all development. The provisions in this Chapter are designed to achieve the following goals:
(a) Increase energy efficiency in buildings;
(b) Increase resource conservation;
(c) Provide durable buildings that are efficient and economical to own and operate;
(d) Promote the health and productivity of residents, workers, and visitors to the city;
(e) Recognize and conserve the energy embodied in existing buildings; and
(f) Reduce disturbance of natural ecosystems.

G This amendment is justified on the basis of a local **geological** condition. The City of Palo Alto is subject to earthquake hazards caused by its proximity to San Andreas fault. This fault runs from Hollister, through the Santa Cruz Mountains, epicenter of the 1989 Loma Prieta earthquake, then on up the San Francisco Peninsula, then offshore at Daly City near Mussel Rock. This is the approximate location of the epicenter of the 1906 San Francisco

earthquake. The other fault is the Hayward Fault. This fault is about 74 mi long, situated mainly along the western base of the hills on the east side of San Francisco Bay. Both of these faults are considered major Northern California earthquake faults which may experience rupture at any time. Thus, because the City is within a seismic area that includes these earthquake faults, the modifications and changes cited herein are designed to better limit property damage as a result of seismic activity and to establish criteria for repair of damaged properties following a local emergency.

T The City of Palo Alto **topography** includes hillsides with narrow and winding access, which makes timely response by fire suppression vehicles difficult. Palo Alto is contiguous with the San Francisco Bay, resulting in a natural receptor for storm and waste water run-off. Also the City of Palo Alto is located in an area that is potentially susceptible to liquefaction during a major earthquake. The surface condition consists mostly of stiff to dense sandy clay, which is highly plastic and expansive in nature. The aforementioned conditions within the City create hazardous conditions for which departure from California Building Standards Codes is warranted.

CITY OF PALO ALTO

Overview of Proposed Local Code Amendments for Immediate Adoption

George Hoyt, Chief Building Official
Tim Scott, Resource Planner

September 8, 2025

Acting Now for a Resilient Future

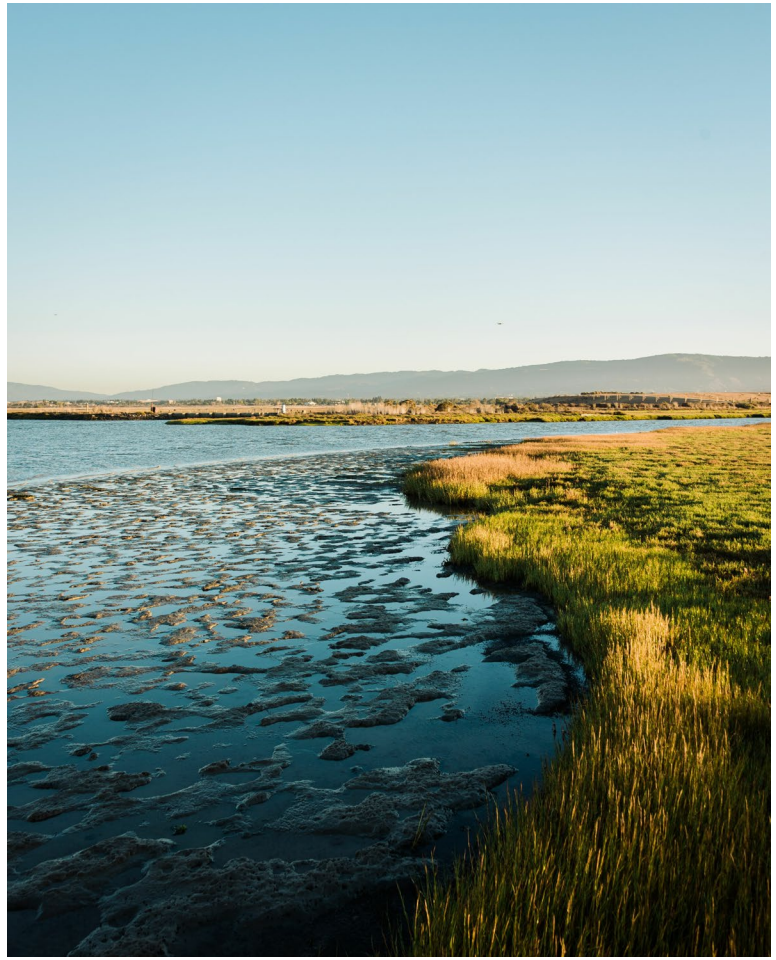
Building Standards Code Update Process

California updates its Building Standards Code every three years.

- Current 2022 code update took effect January 1, 2023
- 2025 code update will take effect January 1, 2026

Local jurisdictions may adopt local amendments to the 2025 model code once the model code is published.

- Must be more restrictive/stringent than the state code
- Must make express findings that each amendment is reasonably necessary due to local geographic, topographical, climatic or environmental conditions



Legislative Updates & Urgency

AB 130 (formerly AB 306) passed on June 30, 2025

Includes language that will limit the ability of jurisdictions to adopt *new residential* local amendments to California Building Standards code starting Oct 1, 2025 through 2031

Today: City Council to consider *new residential* proposals for immediate adoption

October 6, 2025: City Council to consider *new non-residential* proposals for adoption and prior local amendments for readoption

Proposed Local Building Code Amendments to 2022 Code

2022 Building Code Administrative Amendments

- **Certificate of Occupancy Requirements** – Clarifying when a certificate of occupancy is required.

- **Definitions** – Clarifying applicability of certain definitions, such as net floor area and gross floor area.

Proposed Local Energy Code Amendments to 2025 Code

Background

Reach codes consist of local amendments that go beyond the requirements of state code

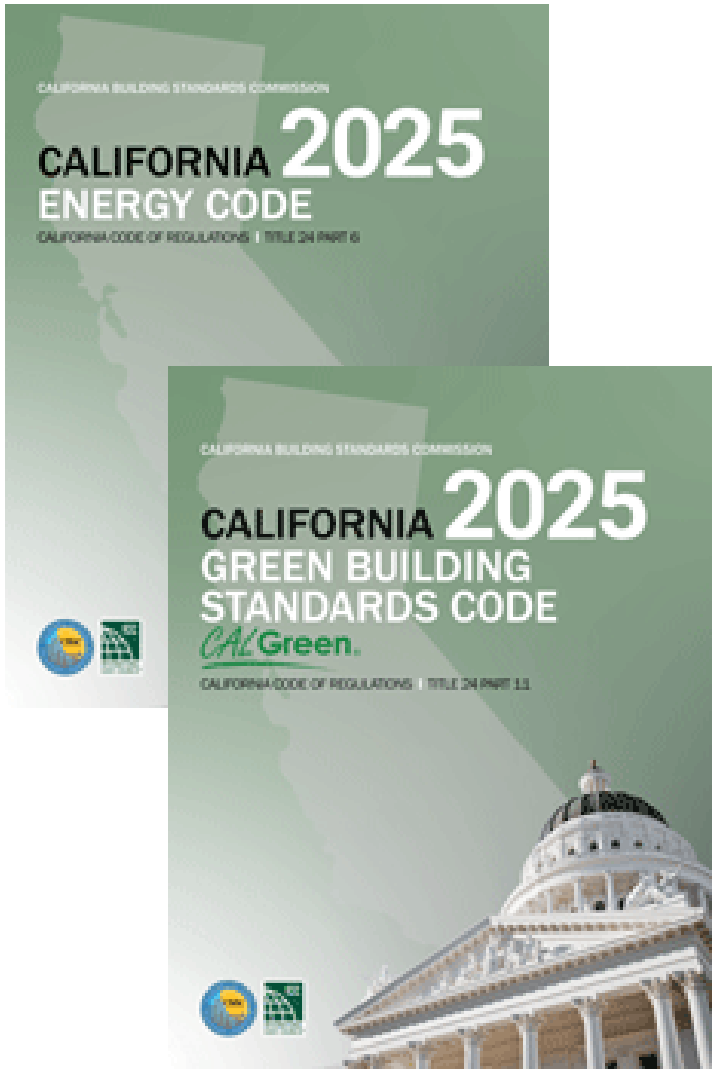
- Updated every 3 years

Energy code - addresses building energy use

- Local amendments must show cost-effectiveness

Green building code (CALGreen) - non-energy environmental impact in areas of:

  - Water Conservation
  - Material Conservation
  - Environmental Quality
  - EV Infrastructure



Green Building and Energy Amendment Timeline

Adoption Date	Local Code Amendments	
	Green Building Reach Code	Energy Reach Code
September 2025	• None	• Air Conditioner Time of Replacement • FlexPath
October 2025	• Carry forward previous local Green Building Code amendments (including CALGreen Tier 1 & 2 adoption) • LEED Certification Alternative Compliance Pathway • Embodied Carbon Threshold • EV Readiness	• Carry forward previous local Energy Code amendments, as supported by cost effectiveness studies
Spring 2026	• None	• Potential additional Energy Code amendments as supported by newly available cost effectiveness studies and model code language. e.g., Gas Water Heater Time of Replacement

Time of Replacement: AC to Heat Pump

Proposal: Beginning 2027, require air conditioner replacement projects to **either:**

- implement additional energy efficiency measures (e.g. attic insulation, air sealing)

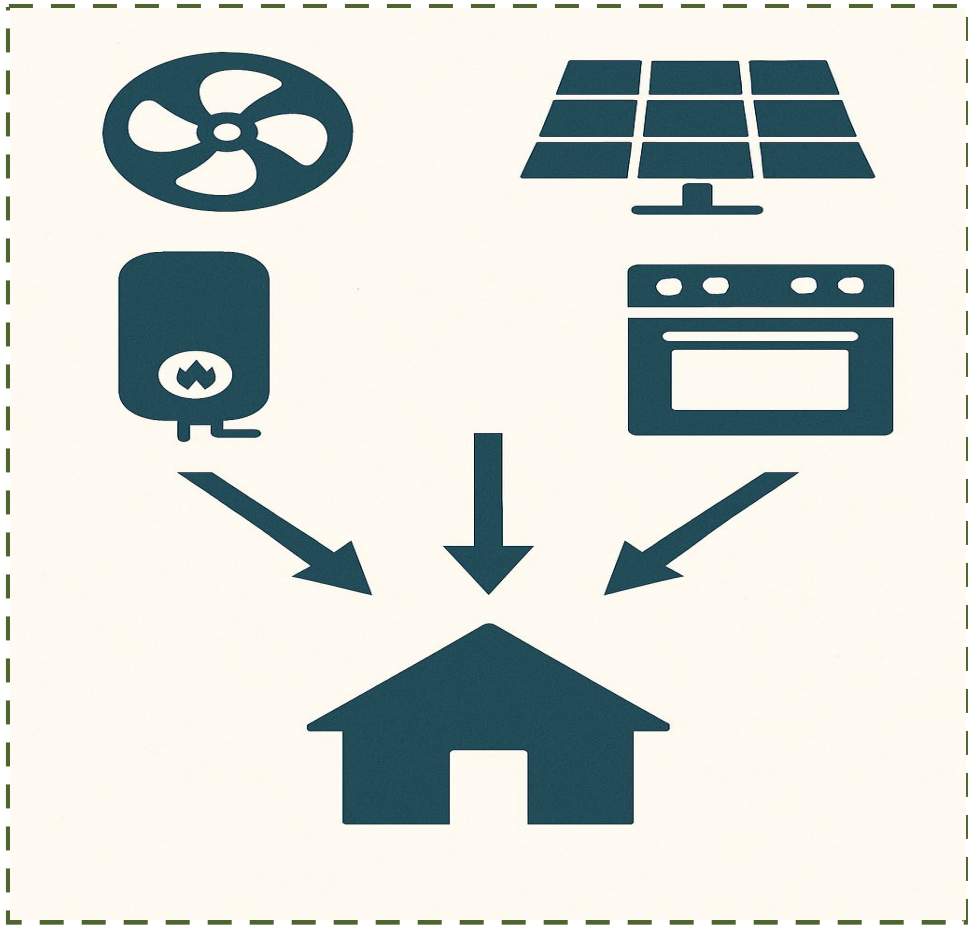
OR

- install a heat pump at time of replacement/upgrade of an AC unit

Objective: Energy efficiency and GHG reduction.

Exceptions: Insufficient electric panel capacity or if capacity of the heat pump would need to be one ton greater than AC unit to meet cooling load

FlexPath



Proposal: Remodel/renovation projects over 1,000 sq. ft. must achieve 12 points installing energy-related measures from a provided list of options.

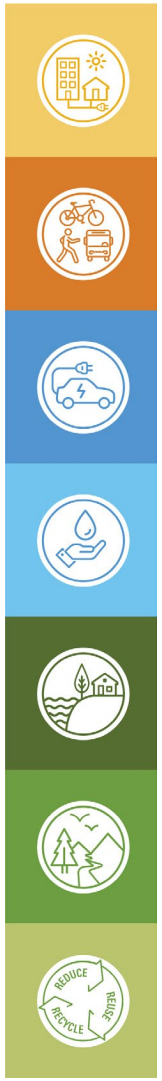
Objective: Energy efficiency and emissions reduction.

FlexPath Measure List

Measures	Building Vintage		
	Pre-1978	1978-1991	1992-2010
Water Heating Package	1	1	1
Air Sealing	2	1	1
R-38 Attic Insulation	7	3	1
R-49 Attic Insulation	7	3	1
Duct Sealing	6	4	1
New Ducts, R-6 Insulation + Duct Sealing	10	7	2
New Ducts, R-8 Insulation + Duct Sealing	11	8	3
Windows	6	5	3
Wall Insulation	6	--	--
R-19 Raised floor insulation	8	8	--
R-30 Raised floor insulation	9	9	--
Radiant Barrier Under Roof (when re-roofing)	3	2	1
Heat Pump Water Heater Replacing Gas	12	12	12
High Eff. Heat Pump Water Heater Replacing Gas	13	13	13
Heat Pump Water Heater Replacing Electric	4	4	4
High Eff. Heat Pump Water Heater Replacing Electric	5	5	5
Heat Pump Space Conditioning System	21	16	13
High Eff. Heat Pump Space Conditioning System	23	18	15
Dual Fuel Heat Pump Space Conditioning System	15	11	10
Heat Pump Clothes Dryer	1	1	1
Induction Cooktop	1	1	1
Solar PV	17	17	15

Measure Point Values

Other Jurisdictions Adoption



AC to Heat Pump:

- Menlo Park (2026)
- Sunnyvale (2026)
- Mountain View (2026)
- Glendale (2026)
- San Jose (2026)

FlexPath:

- Menlo Park
- Ojai
- Carlsbad
- Corte Madera
- Encinitas
- Fairfax
- Marin County
- Piedmont
- San Luis Obispo
- San Rafael
- San Anselmo

Existing Amendment

Community Feedback

Staff hosted two community feedback sessions on August 12th and 13th

Feedback included:

- FlexPath – Suggestions to add new measures or adjust point values
- Water Heaters – Questions on aligning future time of replacement requirement with Air District Zero NOx standards
- Water Conservation – Suggestion for new elective measures to satisfy CALGreen requirements
- Other feedback that staff is considering for the future includes gas stove time of replacement, adopting passive housing standards, adjusting EV readiness requirements, and updating electric load calculations

CASC Feedback

- Discussed pushing AC to Heat Pump enforcement date forward to 2026
    - Determined that 2027 start date makes sense to learn from utility programs and other jurisdiction implementation
- Discussed additional AC to Heat Pump exceptions
    - Included additional information on current exceptions
- Included additional information on FlexPath measure list
- Voted 3 – 0 to recommend City Council adoption of the proposed Energy Code amendments

Staff Recommendation

Staff recommends that the City Council:

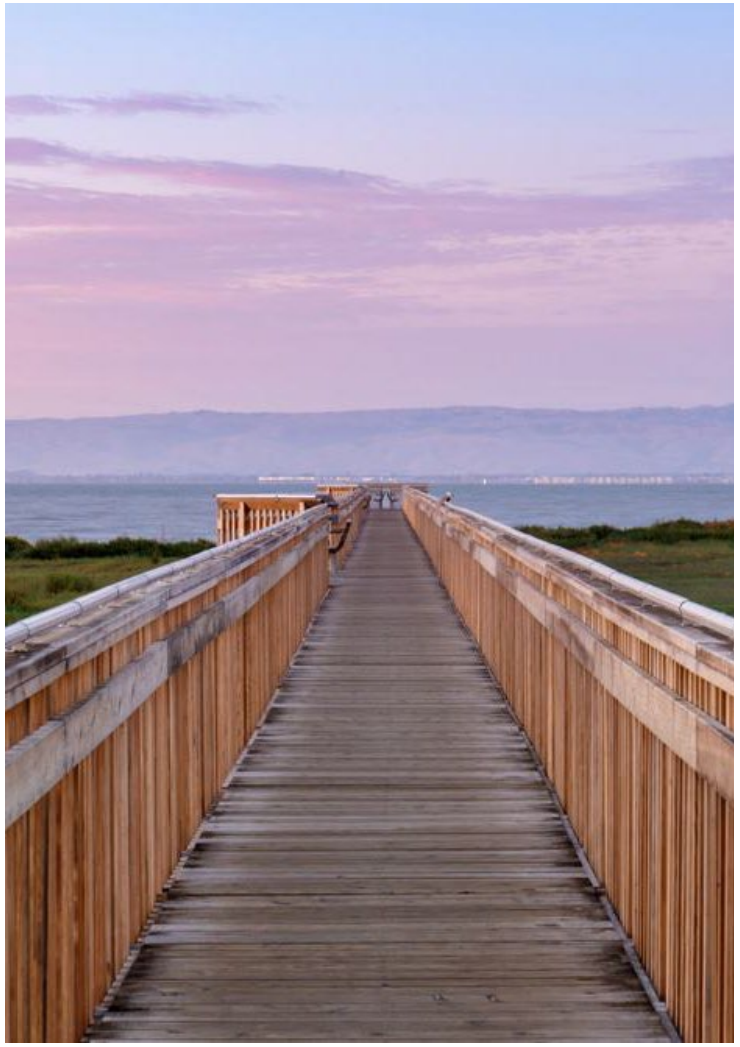
1. Adopt, by a four-fifths majority, the emergency ordinance to incorporate administrative amendments into Palo Alto Municipal Code 16.04, which implements the California Building Code, and

2. Adopt, by a four-fifths majority, the emergency ordinance amending PAMC Chapter 16.17 to incorporate the 2025 Edition of the California Energy Code with local amendments related to energy efficiency.

Next Steps

If the proposed amendments are adopted by the Council, next steps would be:

- Administrative amendments to Building Code would take effect immediately
- Staff would submit Energy Code amendments to the California Energy Commission (CEC) and the California Building Standards Commission (CBSC) for review
  - Review process typically takes ~2 months
- If approved by the CBSC and CEC:
  - Palo Alto's FlexPath amendment would be effective starting Jan 1, 2026 (effective date of the 2025 state code)
  - AC to Heat Pump time of replacement standards would become effective January 1, 2027



CITY OF PALO ALTO

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