



**TO:** Mayor and Councilmembers

**SUBMITTED BY:** Peter Imhof, Planning and Environmental Review Director

**PREPARED BY:** Dana Murray, Sustainability Manager  
Angeline Foshay, Management Analyst

**SUBJECT:** First Reading of Ordinance Amending Title 15, Chapter 15.03 of the Goleta Municipal Code for an Energy Performance Reach Code

**RECOMMENDATION:**

Introduce and conduct the first reading by title only, waiving further reading of Ordinance No. 25-\_\_ entitled, "An Ordinance of the City Council of the City of Goleta, California, Amending Title 15, Chapter 15.03 Entitled "Electrical Code" of the Goleta Municipal Code to Adopt the 2022 Edition of the California Building and Energy Code and Local Amendments Thereto and Determine the Ordinance to be Exempt from the California Environmental Quality Act."

**SUMMARY:**

An Energy Performance Reach Code would modify the California Energy Code within the City to require a higher level of energy performance for new construction. Staff and the Green Committee recommend that the City Council consider adoption of an Energy Performance Reach Code. The proposed ordinance encourages electrification while still allowing for natural gas in buildings, although they may need to comply with additional energy performance measures. These additional measures may include increased energy efficiency (i.e., higher insulation), increased solar panel system size, and battery storage systems. For newly constructed buildings where fuel gas infrastructure is permitted due to any qualifying exceptions, they would be required to have sufficient electrical capacity, including reserved circuit breakers, electrical conduit, subpanels, panels, switchboards, and transformers, to facilitate future full-building electrification.

The ordinance would:

- Require higher energy performance for new single-family, low-rise multifamily buildings and non-residential buildings, including pre-fabricated buildings.

- Provide for either reduced margins or exceptions for smaller homes and accessory dwelling units.
- Extend electric readiness requirements through:
  - Exterior location for space heat pump compressor in single-family;
  - Space and ventilation requirements for in-unit water heaters in multifamily buildings;
  - Electrical capacity requirements for multifamily central hot water systems, with an option to include space, ventilation, and condensate requirements.
- Be implemented through the submission of Title 24 reports, which are already a standard submission for all new projects.

The ordinance would NOT:

- Prohibit or prevent gas technologies.
- Apply to additions and alterations.
- Apply to unregulated loads such as equipment and appliances for cooking, laundry, and pools.

## **BACKGROUND:**

Definitive climate data has revealed the urgent need for regulatory action. In 2016, California responded to this demand by adopting comprehensive goals to reduce GHG emissions and support local governments in carrying out community-level emissions reductions strategies. With the passage of Senate Bill 32 in 2016, California set targets to reduce statewide GHG emissions to 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050. To reach these state emissions targets, decarbonizing the building sector is essential. The primary method for the decarbonization of buildings is electrification, as escalating renewable portfolio standards have been and will continue to reduce the emissions content of our electricity.

The California Air Resources Board (CARB) 2022 Scoping Plan provides an implementation pathway to meet the State's carbon reduction goals. Statewide, residential and commercial buildings are responsible for approximately 25% of California's greenhouse gas (GHG) emissions when accounting for fossil fuels, such as natural gas consumed onsite and via electricity demand. The Scoping Plan recommends all-electric buildings become standard for residential construction starting in 2026 and non-residential construction starting in 2029 to improve indoor air quality and reduce GHG emissions to meet state goals.

In 2020, Goleta's energy use (from both electricity and natural gas) accounted for 40.4% of the community's total emissions. Of that total energy use, natural gas use in buildings accounted for 40% of Goleta's energy emissions. While efforts have been made to decarbonize the natural gas system through the development of renewable natural gas, there are insufficient supplies to properly meet state and local demand, ultimately leaving the full decarbonization of the natural gas system infeasible. As stated in the 2021 California Energy Commission (CEC) Integrated Energy Policy Report, "Building

electrification is the most promising decarbonization strategy and could result in significant reductions in residential and commercial building gas demand.”

Taking action locally, the Goleta City Council voted unanimously to pass an all-electric new construction ordinance on April 18, 2023. However, on April 17, 2023, a three-judge panel of the Ninth Circuit Court of Appeals ruled in *CRA v. City of Berkeley*, that a Berkeley ordinance requiring all-electric new buildings was pre-empted by the federal Energy Policy and Conservation Act of 1975 (EPCA) and was therefore invalid. Due to the Ninth Circuit's decision to overturn the City of Berkeley's natural gas ban for new construction, Goleta's second reading to pass the ordinance was placed on hold. In January 2024, the full Ninth Circuit panel denied the City of Berkeley's request for an *en banc* (full court panel) hearing. In effect, the Ninth Circuit Court of Appeal ruling stands: Berkeley's all-electric ordinance is preempted by federal law, and, as a result, all-electric ordinances by any other city would not survive legal challenge.

Based on Council feedback and unanimous interest in pursuing electrification policy from the April 18, 2023 Council meeting, staff added “New Construction Building Electrification: Evaluate Reach Code Options & Policy Development” to the 2024-2025 PER Annual Work Program. Since the *CRA v. City of Berkeley* decision, many cities in California have evaluated alternative policy approaches to support new construction electrification. Staff has monitored new policy developments and collaborated with the Green Cities Network to find alternative pathways to incentivize electrification for new construction. Many jurisdictions with previously developed or adopted all-electric Reach Codes have been evaluating alternative options to pursue electrification and decarbonize their new and existing building stock. Notably, the Cities of San Luis Obispo, San Jose, Palo Alto, East Palo Alto, Santa Monica, Brisbane, Encinitas, and Santa Cruz have adopted Energy Performance Reach Codes in late 2023 and throughout 2024, which Goleta staff have been tracking closely.

On November 21, 2024, the Goleta City Council Energy & Green Issues Standing Committee was provided an update on building electrification policy and presented with a recommended pathway to improve new construction building performance. Staff were advised to construct a primer or brief to demonstrate the process of compliance for a project applicant and conduct further outreach to the community and developers that may be impacted by policy adoption in 2025. The Committee unanimously supported staff in developing an ordinance and bringing an Energy Performance Reach Code to City Council for review and consideration.

## **DISCUSSION:**

Staff recommends the Goleta City Council consider adopting an Energy Performance Reach Code that would increase the performance requirements for newly constructed buildings, resulting in a reduction of building emissions. This Reach Code would not ban natural gas systems in new construction but require a uniformly applied increase in building performance to drive building decarbonization. The proposed Ordinance is included as Attachment 1.

With the City's all-electric ordinance for new construction on pause, supporting policies and programs that incentivize and remove barriers to electrification in existing buildings provides an opportunity to reduce carbon emissions and improve indoor air quality for Goleta residents. According to CARB, buildings emit about 66 tons per day (tpd) of NOx to the ambient air, about four times the emissions from electric utilities and nearly two-thirds the emissions from light-duty vehicles statewide. Electric heat pumps for space and water heating are more efficient than their natural gas counterparts and have the added safety benefits of lowering the potential for carbon monoxide poisoning and gas explosions.

The most cost-effective time to electrify is during the development of new construction, and new construction provides the best opportunity to avoid "lock-in emissions" which would be created through the inclusion of natural gas infrastructure in new buildings. While it will yield less emissions savings than an all-electric Reach Code, the City can still further support all-electric projects by increasing energy efficiency, solar, and/or battery requirements for both mixed fuel and all-electric buildings because it is typically simpler for all-electric buildings to comply.

Based on these observations, staff recommends adopting an Energy Performance Reach Code to reduce greenhouse gas emissions from new buildings.

#### *Proposed Approach*

Staff have identified local amendments to the California Energy Code (also known as a "Reach Code") to reduce greenhouse gas emissions in new buildings as the preferred alternative approach.

The proposed Energy Performance Reach Code would include requirements for new buildings that would result in higher efficiency and lower operational greenhouse gas emissions. To be consistent with state law, the City must make findings that the proposed Building Code amendments related to building energy performance are cost-effective and use less energy than the standard State Code. The California Energy Commission (CEC) must agree with the City's analysis before the local amendments to the California Energy Code can go into effect.

The California Energy Code establishes whole-building efficiency requirements, which account for a building's water heater, HVAC (heating, ventilation, and air conditioning) system, solar generating system, and insulation, among other things. However, it does not account for cooking equipment, laundry dryers, or other unregulated energy uses. As such, the proposed Energy Performance Reach Code does not regulate cooking equipment, laundry dryers, fireplace, outdoor cooking, or other energy uses not addressed by the California Energy Code.

#### *California Energy Code Energy Evaluation Metrics*

The 2022 California Energy Code provides baseline efficiency and building performance standards that a project must meet before receiving a building permit. The California

Energy Code provides different metrics for different types of buildings. These metrics are summarized below, and described in a Memo (Attachment 2). (For more information, visit: <https://energycodeace.com/resources/?itemId=66025>)

Under the performance pathway of the 2022 Energy Code, new construction buildings must meet energy standards based on efficiency, emissions, and energy use. Single-family homes are rated using Energy Design Ratings (EDR), which measure energy efficiency, energy costs, solar impacts and more. A key focus of this proposal is the EDR1 metric, commonly known as hourly source energy.

Multi-family and non-residential buildings use similarly intentioned metrics and must meet standards for energy cost, emissions, and solar or battery contributions. The key metric of importance for this proposal is the "Source Energy" metric, which promotes renewable energy and decarbonization.

### *Proposed Energy Performance Enhancements*

Public Resources Code Section 25402.1(h)(2) and Section 10-106 of the Building Energy Efficiency Standards establish a process that allows local adoption of energy standards that are more stringent than the statewide standards. Under this process, the CEC requires any local amendments to the California Energy Code that affect energy use in regulated buildings to be cost-effective and use less energy than the standard requirements.

As noted in Table 1 below, the EDR1 of single-family residential new buildings would be required to be less than the EDR1 of the standard design by a compliance margin of at least 5 points. Smaller single-family homes would have a reduced compliance margin requirement of 2 points due to their smaller size and energy usage and thus lower capacity for energy improvements. Accessory dwelling units (ADUs) are exempt.

Table 1 also identifies a Source Energy performance requirement for new multi-family residential buildings (7% better than code for low-rise [three stories or fewer]). High-rise [four stories or more] is not included as the State Code prescriptively requires a battery storage system in this building type, making it more difficult to comply with an extended reach beyond the state code.

New non-residential buildings would be required to have a compliance margin of 2%-14%, depending on the building type. Office facilities have a higher compliance margin of 14% because they tend to have larger conditioned floor areas, which translates to higher savings potential.

An exemption is available for non-residential projects designed with single-zone space-conditioning systems where California Energy Code Section 140.4(a)2 is applicable because the State Code prescriptively requires the use of heat pumps, making it difficult for mixed-fuel buildings to comply already.

Due to how EDR1 and Source Energy scores are calculated in the 2022 California Energy Code, the higher standards proposed in the Reach Code would incentivize new buildings to select electric appliances/mechanical systems, while also allowing mixed-fuel buildings that include energy efficiency measures, solar, and/or a battery. The enhanced performance requirements would apply equally to mixed-fuel and all-electric buildings and are cost-effective to achieve through the Energy Code's performance pathway without requiring appliances that exceed federal efficiency standards.

**Table 1. Proposed Improved Energy Performance Standards**

| <b>Building Type</b>                  | <b>Performance Requirement</b>   |
|---------------------------------------|--|
| <b>Single-Family Residential</b>      | Buildings > 1,500 sq. ft. - EDR1 compliance margin of at least 5 points<br>Buildings <1,500 sq. ft. – EDR1 compliance margin of at least 2 points  |
| <b>Multi-Family Residential (Low)</b> | Source Energy compliance margin of at least 7%   |
| <b>Non-Residential</b>                | Source Energy compliance margin of at least the following:<br>Hotel – 7%<br>Small Restaurants – 2%<br>Office – 14%<br>All Other Building Types – 7%  |
| <b>Exceptions</b>                     | <b>Single Family:</b> Accessory Dwelling Units (ADUs)<br><b>Non-residential:</b> When non-residential occupancies are designed with single zone space-conditioning systems complying with Section 140.4(a)2. |

### *Electric Ready Requirements*

The 2022 California Energy Code currently requires certain mixed-fuel buildings to include “electric-ready” components, including electric outlets near certain natural gas appliances, appropriate ventilation for future heat pump appliances, and reserved and labelled breakers in the electrical panel for future electric appliances.

The proposed Reach Code adds to the 2022 California Energy Code by including electric readiness provisions (which are coming 2025 California Energy Code and will be effective on January 1, 2026). This Reach Code essentially brings forward the coming electric readiness regulation by several months.

### *Practical Effect of the Energy Performance Reach Code*

Because the City is working within the confines of the California Energy Code, the description of the proposed approach above is inherently technical. This section illustrates the practical effect of the proposed approach by providing a simplified example of how a single-family home designer would comply with the Energy Performance Reach Code.

A building designer working on a single-family home built to the State's Energy Code minimum would likely include high efficiency LED lighting, rooftop solar, an electric heat pump hot water heater, a natural gas furnace, insulated walls, an insulated attic, and efficient windows, among other things. The designer would load the building design into a computer model and estimate its energy performance. The energy modeling software would provide standard reporting metrics, including an EDR1 score. The designer would then compare the EDR1 score to a standard design building on the CF-1R form. The designed building's EDR1 score would be equal to the standard design building's EDR1 score and would comply with that part of the California Energy Code.

With the Reach Code in place, the designer would now need to achieve an EDR1 compliance margin that is 5 points better than the standard design building. If this building designer replaced the gas furnace with a commonly available electric heat pump HVAC system, the building would achieve an EDR1 compliance margin that is 5 points better than the State Code's minimum and would be consistent with the proposed Reach Code requirements. Alternately, the building designer could keep the gas furnace and install a battery storage system, which would also result in an improved EDR1 compliance margin of more than 5 points. The building designer also has the option to develop a package of efficiency and solar measures; so long as the measures lead to an increased EDR1 compliance margin of 5 or more points better than the State Code's minimum, the new building is consistent with the Reach Code.

This example is similar for the other building types where the compliance margins could be achieved by either installing electric heat pump HVAC equipment or installing some package of additional solar capacity and efficiency measures.

### *Cost-Effectiveness*

The California Energy Commission requires any local amendments to the California Energy Code that affect energy use in regulated buildings to be cost-effective and to use less energy than the standard requirements. The CEC requires the local agency to adopt a determination that the energy standards are cost-effective at a public meeting. The determination must subsequently be filed with the Energy Commission. In support of Reach Code development, the California Energy Codes and Standards Statewide Utility Program developed and published the following studies:

- 2022 Cost-Effectiveness Study: [Single Family New Construction Study](#) and the [associated cost-effectiveness data](#);
- 2022 Cost-Effectiveness Study: [Multifamily New Construction Study](#) and the [associated cost-effectiveness data](#); and
- 2022 Code: [Non-residential New Construction Reach Code Cost-effectiveness Study](#) and the [associated cost-effectiveness data](#).

These studies and the associated cost-effectiveness data are highly detailed and are included in the record to support Green Committee and Council's findings and policy decisions (Attachment 3). These studies and the associated cost-effectiveness data are

the basis for staff's cost-effectiveness findings and are sufficient to illustrate compliance with the requirements set forth under California Administrative Code Chapter 10-106.

Based on these studies, staff finds the proposed local amendments to the 2022 California Energy Code to be cost-effective and consume less energy than otherwise permitted by Title 24, Part 6.

### *Incentives*

Incentive and rebate programs are available to support the development of all-electric housing and the adoption of clean energy solutions, contributing to California's decarbonization goals. Notably, Central Coast Community Energy (3CE) provides rebates for housing developers and homeowners to build all-electric housing. Rebates are available for multiple types of housing developments, with enhanced rebates available for homeowners building Accessory Dwelling Units (ADUs) and for Single-family Disaster Rebuilds. See Attachment 4 for more information on rebates and incentives.

### *Public Engagement*

As described in the 2023 Council Agenda reports, extensive outreach was conducted in various community forums and settings affirming that all-electric new buildings are feasible, cost-effective, and supportive of the City's climate action goals. The City coordinated and collaborated with the County of Santa Barbara, City of Carpinteria, and numerous utilities, consultants and energy-focused organizations to conduct outreach. The regional group organized an Advisory Committee of stakeholders, hosted multiple public workshops discussing Reach Codes and the benefits of electrification, and conducted targeted outreach to the South Coast Chamber of Commerce, the Joint Affordable Housing Task Group, Santa Barbara Association of Realtors and the Regional Climate Collaborative Equity and Outreach Subcommittee. The work conducted in support of the previous all-electric Reach Code provides a groundwork of understanding around building electrification in the community and supports any future Council policies related to low-emissions new buildings.

Staff has continued to collaborate with the County of Santa Barbara, City of Santa Barbara, and the City of Carpinteria, including recent meetings with regional stakeholders such as the South Coast Chamber of Commerce Public Policy Committee and Santa Barbara Association of Realtors. In addition to targeted stakeholder outreach, on January 14, 2025, staff collaborated with the County of Santa Barbara to conduct additional community outreach on the Energy Performance Reach Code through a public workshop with various stakeholders in attendance, where staff presented on the Reach Code and held a discussion with the public and answered three questions that were asked.

### *Timing & Next Steps*

Should City Council move forward with the first reading, it would be followed by a second reading for adoption. Before the Reach Code is implemented, the California Energy Commission (CEC) must approve the local energy code following the second reading.

The CEC ensures that the local energy Reach Code improves building energy performance, is cost-effective and does not pre-empt Federal standards regulating appliance energy use. It is important to note that the California Building Code, which includes the California Energy Code, is updated every three years. Should City Council adopt the Energy Performance Reach Code, the local Reach Code would expire with the current Building Code on December 31, 2025. Staff is already coordinating regionally with other jurisdictions in San Luis Obispo County and Santa Barbara County on developing potential Reach Codes for the next cycle.

**FISCAL IMPACTS:**

There is no fiscal impact associated with this item.

**GOLETA STRATEGIC PLAN:**

**City-Wide Strategy: 1.** Support Environmental Vitality

**Strategic Goal:**

- **1.1.3.** Encourage renewable energy generation and use through installation of solar panels, battery energy storage, electric vehicle charging stations and similar measures
- **1.1.4.** Adopt a "Reach" Building Code

**CALIFORNIA ENVIRONMENTAL QUALITY ACT:**

This ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. Adoption of the proposed amendment would not be an activity with potential to cause significant effect on the environment. Therefore, it can be seen with certainty that there is no possibility that the ordinance in question may have a significant effect on the environment; accordingly, the ordinance is categorically exempt from CEQA. A copy of the NOE is provided as an Attachment.

**ALTERNATIVES:**

1) Amend the ordinance and introduce it; or 2) direct staff to return with further information; or 3) take no action.

**LEGAL REVIEW BY:** Isaac Rosen, Acting City Attorney

**APPROVED BY:** Robert Nisbet, City Manager

**ATTACHMENTS:**

1. Ordinance No. 25-\_\_ entitled, "An Ordinance of the City Council of the City of Goleta, California, Amending Title 15, Chapter 15.03 Entitled "Electrical Code" of the Goleta Municipal Code to Adopt the 2022 Edition of the California Building and Energy Code and Local Amendments Thereto and Determine the Ordinance to be Exempt from the California Environmental Quality Act"
2. Memo on Energy Performance Approach for Goleta Reach Code
3. 2022 Cost Effectiveness Studies (Multifamily, Single-family, Non-residential)
4. Building Performance Incentives
5. CEQA Notice of Exemption
6. Presentation

## **ATTACHMENT 1**

**Ordinance No. 25-\_\_ entitled, “An Ordinance of the City Council of the City of Goleta, California, Amending Title 15, Chapter 15.03 Entitled “Electrical Code” of the Goleta Municipal Code to Adopt the 2022 Edition of the California Building and Energy Code and Local Amendments Thereto and Determine the Ordinance to be Exempt from the California Environmental Quality Act”**

## ORDINANCE NO 25-\_\_

**AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF GOLETA, CALIFORNIA, AMENDING TITLE 15, CHAPTER 15.03 ENTITLED “ELECTRICAL CODE” OF THE GOLETA MUNICIPAL CODE TO ADOPT THE 2022 EDITION OF THE CALIFORNIA BUILDING AND ENERGY CODE AND LOCAL AMENDMENTS THERETO AND DETERMINE THE ORDINANCE TO BE EXEMPT FROM THE CALIFORNIA ENVIRONMENTAL QUALITY ACT**

**WHEREAS** California Health and Safety Code section 17958 requires that cities adopt building regulations that are substantially the same as those adopted by the California Building Standards Commission and contained in the California Building Standards; and

**WHEREAS** the California Energy Code is a part of the California Building Standards which implements minimum energy efficiency standards in building through mandatory requirements, prescriptive standards, and performance standards; and

**WHEREAS** California Health and Safety Code Sections 17958.5, 17958.7 and 18941.5 provide that the City may make changes or modifications to the building standards contained in the California Building Standards based upon express finding that such changes or modifications are reasonably necessary because of local climatic, geological or topographical conditions; and

**WHEREAS** the City Council of the City of Goleta finds that each of the amendment additions and deletions to the California Energy Code contained in this ordinance are reasonably necessary because of local climatic, geological or topographical conditions; and

**WHEREAS** Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards (Standards) establish a process which allows local adoption of energy standards that are more stringent than the statewide Standards, provided that such local standards are cost effective and the California Energy Commission finds that the standards will require building to be designed to consume no more energy than permitted by the California Energy Code; and

**WHEREAS** on or about September 20, 2016, the State of California enacted Senate Bill (SB) 32, which added Health and Safety Code Section 38566 to require greenhouse gas emissions to be reduced to 40 percent below 1990 levels by no later than December 31, 2030; and

**WHEREAS** the State of California updates and sets Building Codes and Standards on a triennial cycle for single-family, multifamily and nonresidential structures with the intended purpose to improve building efficiency and reduce greenhouse gas emissions; and

**WHEREAS** the City's local amendments to the 2022 California Building Codes, including the California Green Building Code, increase requirements for single-family (e.g., townhomes), multifamily, and nonresidential structures beyond that of the State's requirement because, based on local climatic, geological or topographical conditions, they are necessary to reduce demands for local energy and resources, reduce regional pollution, and promote a lower contribution to greenhouse gases emissions; and

**WHEREAS** the content and details of this ordinance were the subject of a public stakeholder workshop conducted on January 14, 2025, which included numerous stakeholders; and

**WHEREAS** staff has reviewed the cost effectiveness studies prepared by the California Statewide Codes and Standards Reach Code Program and associated study data and find them sufficient to illustrate compliance with the requirements set forth under California Administrative Code Chapter 10-106; and

**WHEREAS** the City's local amendments will result in designs that consume less energy than they would under the 2022 State Energy Code through the California Statewide Codes and Standards Reach Code Program, has performed cost effectiveness analyses as required by the California Energy Commission for the local amendments to the California Energy Code contained in this ordinance which is hereby incorporated by reference; and

**WHEREAS** based upon these analyses, the City Council of the Goleta finds that the local amendments to the California Energy Code contained in this ordinance have at least one cost effective pathway and will require buildings to be designed to consume no more energy than permitted by the California Energy Code; and

**WHEREAS** the Goleta City Council adopted a determination at a public meeting on [Month Day, Year], that the locally adopted energy efficiency standards contained in [Ordinance No. XX-XXXX] are cost-effective; and

**WHEREAS** adoption of Reach Codes support the Goleta City Council's Strategic Plan and climate action goals, which aim to reduce communitywide GHG emissions; and

**WHEREAS** the Goleta City Council adopted the 2023-24 and 2024-25 Planning and Environmental Review Annual Work Programs, which included developing Reach Codes that further building electrification as a top priority; and

**WHEREAS** scientific evidence has established that GHG accumulation in the atmosphere as the result of human activity is the primary cause of the global climate crisis; and

**WHEREAS**, in California alone, the initial impacts of climate change have resulted in unprecedented disasters with consequential human, economic, and environmental costs; and

**WHEREAS** the climate change crisis is happening now, impacting Goleta in unprecedented ways, and affecting the health and safety of the Goleta community; and

**WHEREAS** the Intergovernmental Panel on Climate Change estimates that global emissions need to be reduced by 45% from 2010 levels by 2030, and 100% by 2050 to prevent global catastrophe; and

**WHEREAS**, in 2016, the State of California enacted Senate Bill (SB) 32 to require GHG emissions to be reduced to 40% below 1990 levels by 2030 and in 2018 Governor Brown issued Executive Order B-55-18 establishing a statewide target of carbon neutrality by 2045; and

**WHEREAS** achieving climate goals will require action at all levels, including individual, community, local and state government, businesses and utilities, in order to protect the health and welfare of the community, while meeting state and federal efforts; and

**WHEREAS** the City must accelerate our actions to mitigate and adapt to climate change in Goleta, and more quickly move toward a low-carbon, sustainable, and resilient future; and

**WHEREAS**, in California alone, the initial impacts of climate change have resulted in unprecedented disasters with consequential human, economic, and environmental costs; and

**WHEREAS** Goleta is already experiencing and is at risk of more frequently experiencing the devastating effects of extreme heat and weather events and flooding caused by climate change, including increased frequency and magnitude of wildfires and associated air pollution, health impacts, utility and transportation service interruptions, economic disruption, property loss, dislocation, housing shortages, and increased demand on public sector resources and emergency response capacity; and

**WHEREAS** the City of Goleta is situated along a wildland-urban interface and as a result is extremely vulnerable to wildfires and firestorms according to the Federal Emergency Management Authority (FEMA) Wildfire Risk Index Map; and

**WHEREAS** Santa Barbara County is ranked in the 99.4<sup>th</sup> national percentile and 84.5<sup>th</sup> percentile in California for the natural hazard risk index; and

**WHEREAS**, because of the City's unique local climatic, geologic and topographic conditions, the City desires to make amendment and additions to the code.

**WHEREAS** using electric heating and cooling infrastructure in new buildings fueled by less greenhouse gas intensive electricity is linked to significantly lower greenhouse gas emissions and is cost competitive because of the cost savings associated with all-electric designs that avoid new gas infrastructure; and

**WHEREAS** the most cost-effective time to integrate electrical infrastructure is in the design phase of a building project because building systems and spaces can be designed to optimize the performance of electrical systems and the project can take full advantage of avoided costs and space requirements from the elimination of natural gas piping and venting for combustion air safety; and

**WHEREAS** it is the intent of the City Council to reduce natural gas emissions in new buildings where all electric infrastructure can be most practicably integrated, thereby reducing the environmental and health hazards produced by the consumption and transportation of natural gas; and

**NOW THEREFORE THE CITY COUNCIL OF THE CITY OF GOLETA DOES HEREBY ORDAIN AS FOLLOWS:**

#### **SECTION 1. RECITALS.**

The City Council hereby finds and determines that the foregoing recitals, which are incorporated herein by reference, are true and correct.

#### **SECTION 2. PUBLIC HEALTH AND SAFETY FINDINGS.**

Pursuant to California Health and Safety Code Sections 17958.5, 17958.7, and 18941.5, the City of Goleta City Council declares that the following amendments to the Goleta Green Building Code are reasonably necessary due to local climactic, geological, or topographical conditions listed below and as set forth in the Recitals incorporated herein.

Goleta is already experiencing and is at risk of more frequently experiencing the devastating effects of extreme heat and weather events and flooding caused by climate change, including increased frequency and magnitude of wildfires and associated air pollution, health impacts, utility and transportation service interruptions, economic disruption, property loss, dislocation, housing shortages, and increased demand on public sector resources and emergency response capacity.

The City of Goleta is situated along a wildland-urban interface and as a result is extremely vulnerable to wildfires and firestorms according to the Federal Emergency Management Authority (FEMA) Wildfire Risk Index Map. Santa Barbara County is ranked in the 99.4<sup>th</sup> national percentile and 84.5<sup>th</sup> percentile in California for the natural hazard risk index.

According to the 100-year and 500-year flood maps provided by FEMA, the City of Goleta has a significant risk of flooding during extreme weather events and flood events can

majorly disrupt access to utilities, emergency services, and transportation. Extreme weather events are expected to increase as the climate warms due to the greenhouse gas effect.

The amendment is in the interests of public health and safety and general community welfare, as City residents suffer from asthma and other health conditions associated with poor air quality exacerbated by burning fossil fuels. Census tract 6083003001, located in Old Town Goleta, is in the 85<sup>th</sup> percentile for pollution burden in the state, designating this tract as a state recognized Disadvantage Community per SB 535 and indicated in CalEnviroScreen 4.0.

The local amendments to the 2022 California Green Building Standards Code implemented by this ordinance will reduce GHG emissions within the City with the intent to reduce the City's contributions to climate change and in turn reduce the impacts of climate change.

**SECTION 3. ENVIRONMENTAL FINDINGS.** The City Council hereby finds and determines that this ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines, § 15061(b)(3), which states that CEQA does not apply, "where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment." These standards are more stringent than the State energy standards, and as such, there are no reasonably foreseeable adverse impacts, and there is no possibility that the Ordinance in question may have a significant effect on the environment. Adoption of the ordinance would not be an activity with potential to cause significant effect on the environment because the adoption and local amendments to the California Energy Code are enacted to provide more protection to the environment and therefore is exempt from CEQA. Therefore, it can be seen with certainty that there is no possibility that the ordinance in question may have a significant effect on the environment; accordingly, the ordinance is categorically exempt from CEQA.

#### **SECTION 4. CODE AMENDMENT.**

Chapter 15.03 Electrical Code of Title 15 of the Goleta Municipal Code is hereby amended to read in its entirety as follows:

##### **15.03.010 Adoption of Electrical Code**

##### **15.03.020 Local Amendments to Definitions**

##### **15.03.030 Local Amendments to Nonresidential, Hotel/Motel Occupancies and Covered Processes – Mandatory Requirements**

##### **15.03.040 Local Amendments to Nonresidential and Hotel/Motel Occupancies – Mandatory Requirements for Lighting Systems and Equipment and Electrical Power Distribution Systems**

**15.03.050 Local Amendments to Nonresidential and Hotel/Motel Occupancies – Performance and Prescriptive Compliance Approaches for Achieving Energy Efficiency**

**15.03.060 Local Amendments to Single-Family Residential Buildings – Mandatory Features and Devices**

**15.03.070 Local Amendments to Single-Family Residential Buildings – Performance and Prescriptive Compliance Approaches**

**15.03.080 Local Amendments to Multifamily Buildings – Mandatory Requirements**

**15.03.090 Local Amendments to Multifamily Buildings – Performance and Prescriptive Compliance Approaches**

**15.03.010 Adoption of Electrical Code**

A. The California Electrical Code, 2022 Edition including the appendices thereto, except as may be amended by this chapter, are hereby adopted as the Electrical Code of the City.

B. One copy of the California Electrical Code shall be at all times maintained in the office of the Building Official for use and examination by the public.

**15.03.020 Local Amendments to Definitions**

A. Chapter 1 "All Occupancies – General Provisions," Section 100.1(b), "Definitions and Rules of Construction," of Chapter 1 of the Electrical Code is amended to add the following definitions:

**ELECTRIC HEATING APPLIANCE.** 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.

**KITCHEN, INSTITUTIONAL COMMERCIAL** is a kitchen dedicated to a foodservice establishment that provides meals at institutions including schools, colleges and universities, hospitals, correctional facilities, private cafeterias, nursing homes, and other buildings or structures in which care or supervision is provided to occupants.

**KITCHEN, QUICK-SERVICE COMMERCIAL** is a kitchen dedicated to an establishment primarily engaged in providing fast food, fast casual, or limited services. Food and drink may be consumed on premises, taken out, or delivered to the customer's location.

**NET FREE AREA (NFA)** is the total unobstructed area of the air gaps between louver and grille slats in a vent through which air can pass. The narrowest distance between two slats, perpendicular to the surface of both slats is the air gap height. The narrowest width of the gap is the air gap width. The NFA is the air gap height multiplied by the air gap width multiplied by the total number of air gaps between slats in the vent.

### **15.03.030 Local Amendments to Nonresidential, Hotel/Motel Occupancies and Covered Processes – Mandatory Requirements**

A. Section 120.2 “Required Controls for Space-Conditioning Systems” of Subchapter 3 is amended to add Section 120.2(l) to be numbered, entitled and to read as follows:

(a) – (k): Subsections 120.2(a) – (k) are adopted without modification.

(l) HVAC Hot Water Temperature. Zones that use hot water for space heating shall be designed for a hot water supply temperature of no greater than 130 °F.

B. Section 120.6 “General” of Subchapter 3 is amended to add Section 120.6 to be numbered, entitled, and to read as follows:

(a) – (j): Subsections 120.6(a) – (j) are adopted without modification.

(k) Mandatory requirements for commercial kitchens. Electric Readiness for Newly Constructed Commercial Kitchens shall meet the following requirements:

1. Quick-service commercial kitchens and institutional commercial kitchens shall include a dedicated branch circuit wiring and outlet that would be accessible to cookline appliances and shall meet all of the following requirements:

a. The branch circuit conductors shall be rated at 50 amps minimum.

b. The electrical service panel shall have a minimum capacity of 800 connected amps.

2. The electrical service panel shall be sized to accommodate an additional either 208v or 240v 50-amp breaker.

EXCEPTION 1 to Section 120.6(k): healthcare facilities.

EXCEPTION 2 to Section 120.6(k): all-electric commercial kitchens.

**15.03.040 Local Amendments to Nonresidential and Hotel/Motel Occupancies – Mandatory Requirements for Lighting Systems and Equipment and Electrical Power Distribution Systems**

A. Section 130.0 “Lighting Systems and Equipment, and Electrical Power Distribution Systems – General” of Subchapter 4 is amended to read as follows:

a. The design and installation of all lighting systems and equipment in nonresidential and hotel/motel buildings, outdoor lighting, and electrical power distribution systems within the scope of Section 100.0(a), shall comply with the applicable provisions of Sections 130.0 through ~~430.5~~130.6.

**NOTE:** The requirements of Sections 130.0 through ~~430.5~~130.6 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 130.0 through ~~430.5~~130.6 also apply to additions and alterations to existing buildings.

B. Section 130.6 “Electric Readiness Requirements for Systems Using Gas or Propane” of Subchapter 4 is amended to add Section 130.6 to be numbered, entitled and to read as follows:

**130.6 Electric Readiness Requirements for Systems Using Gas or Propane**  
Where nonresidential systems using gas or propane are installed, the construction drawings shall indicate electrical infrastructure and physical space accommodating the future installation of an electric heating appliance in the following ways, as certified by a registered design professional or licensed electrical contractor.

a) Branch circuit wiring, electrically isolated and designed to serve all electric heating appliances in accordance with manufacturer requirements and the California Electrical Code, including the appropriate voltage, phase, minimum amperage, and an electrical receptacle or junction box within five feet of the appliance that is accessible with no obstructions. Appropriately sized conduit may be installed in lieu of conductors; and

b) Labeling of both ends of the unused conductors or conduit shall be with “For Future Electrical Appliance”; and

c) Reserved circuit breakers in the electrical panel for each branch circuit, appropriately labeled (e.g. “Reserved for Future Electric Range”), and

positioned on the opposite end of the panel supply conductor connection; and

d) Connected subpanels, panelboards, switchboards, busbars, and transformers shall be sized to serve the future electric heating appliances. The electrical capacity requirements shall be adjusted for demand factors in accordance with the California Electric Code; and

e) Physical space for future electric heating appliances, including equipment footprint, and if needed a pathway reserved for routing of ductwork to heat pump evaporator(s), shall be depicted on the construction drawings. The footprint necessary for future electric heating appliances may overlap with non-structural partitions and with the location of currently designed combustion equipment.

#### **15.03.050 Local Amendments to Nonresidential and Hotel/Motel Occupancies – Performance and Prescriptive Compliance Approaches for Achieving Energy Efficiency**

A. Section 140.0 “Performance and Prescriptive Compliance Approaches” of Subchapter 5 is amended to read as follows:

Nonresidential and hotel/motel buildings shall comply with all of the following:

- a) The requirements of Sections 100.0 through 110.12 applicable to the building project (mandatory measures for all buildings).
- b) The requirements of Sections 120.0 through 130.56 (mandatory measures for nonresidential and high-rise residential and hotel/motel buildings).
- c) Either the performance compliance approach (energy budgets) specified in Section 140.1 or the prescriptive compliance approach specified in Section 140.2 for the Climate Zone in which the building will be located. Climate zones are shown in FIGURE 100.1-A.

NOTE to Section 140.0(c): The Commission periodically updates, publishes and makes available to interested persons and local enforcement agencies precise descriptions of the Climate Zones, which is available by zip code boundaries depicted in the Reference Joint Appendices along with a list of the communities in each zone.

NOTE to Section 140.0: The requirements of Sections 140.1 through 140.10 apply to newly constructed buildings. Section 141.0 specifies which requirements of Section 140.1 through 140.10 also apply to additions or alterations to existing buildings.

B. Section 140.1 “Performance Approach: Energy Budgets” of Subchapter 5 is amended to read as follows:

A building complies with the performance approach if provided that:

1. The time-dependent valuation (TDV) energy budget calculated for the Proposed Design Building under Subsection (b) is no greater than the TDV energy budget calculated for the Standard Design Building under Subsection (a), and
2. The source energy budget calculated for the proposed design building under Subsection (b) has a source energy compliance margin, relative to the energy budget calculated for the standard design building under Subsection (a), of at least 7 percent for all nonresidential occupancies.

EXCEPTION 1 to 140.1 item 2. A source energy compliance margin of 0 percent or greater is required when nonresidential occupancies are designed with single zone space-conditioning systems complying with Section 140.4(a)2.

(a) – (c): Subsections 140.1 (a) – (c) are adopted without modification.

### **15.03.060 Local Amendments to Single-Family Residential Buildings – Mandatory Features and Devices**

A. Section 150.0 “Mandatory Features and Devices” of Subchapter 7 is amended as follows:

Single-family residential buildings shall comply with the applicable requirements of Sections 150(a) through 150.0(v).

**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(r) also apply to additions or alterations. The amendments to sections 150.0 (t) do not apply to additions or alterations.

(a) – (s): 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 with either a drain or natural drainage for condensate.

(u) – (v): Subsections 150.0(u) – (v) are adopted without modification.

### **15.03.070 Local Amendments to Single-Family Residential Buildings – Performance and Prescriptive Compliance Approaches**

A. Section 150.1 “Performance and Prescriptive Compliance Approaches for Single Family Residential Buildings” of Subchapter 8 is amended to read as follows:

(a) Section (a) is adopted without modification

(b) Performance Standards. A building complies with the performance standards if the energy consumption calculated for the proposed design building is no greater than the energy budget calculated for the standard design building using Commission-certified compliance software as specified by the Alternative Calculation Methods Approval Manual, as specified in sub-sections 1, 2 and 3 below.

1. Newly Constructed Buildings. The Energy Budget for newly constructed buildings is expressed in terms of the Energy Design

Ratings, which are based on source energy and time-dependent valuation (TDV) energy. The Energy Design Rating 1 (EDR1) is based on source energy. The Energy Design Rating 2 (EDR2) is based on TDV energy and has two components, the Energy Efficiency Design Rating, and the Solar Electric Generation and Demand Flexibility Design Rating. The total Energy Design Rating shall account for both the Energy Efficiency Design Rating and the Solar Electric Generation and Demand Flexibility Design Rating. The proposed building shall separately comply with the Source Energy Design Rating, Energy Efficiency Design Rating and the Total Energy Design Rating. A building complies with the performance approach if the TDV energy budget calculated for the proposed design building is no greater than the TDV energy budget calculated for the Standard Design Building AND Source Energy compliance margin of at least 5, relative to the Source Energy Design Rating 1 calculated for the Standard Design building.

EXCEPTION 1 to Section 150.1(b)1. A community shared solar electric generation system, or other renewable electric generation system, and/or community shared battery storage system, which provides dedicated power, utility energy reduction credits, or payments for energy bill reductions, to the permitted building and is approved by the Energy Commission as specified in Title 24, Part 1, Section 10-115, may offset part or all of the solar electric generation system Energy Design Rating required to comply with the Standards, as calculated according to methods established by the Commission in the Residential ACM Reference Manual.

EXCEPTION 2 to Section 150.1(b)1. A newly constructed building with a conditioned floor area less than 1,500 square feet shall achieve a Source Energy compliance margin of 2 or greater, relative to the Source Energy Design Rating 1 calculated for the Standard Design building.

EXCEPTION 3 to Section 150.1(b)1. If due to conditions specific to the project it is technically infeasible to achieve compliance, the Building Official may reduce the compliance margin for a dwelling unit of not more than 1,500 square feet of conditioned floor space.

EXCEPTION 4 to Section 150.1(b)1. A newly constructed Accessory Dwelling Unit, as defined by Goleta Municipal Code [Section 17.41.030](#), shall achieve a Source Energy compliance margin of 0 or greater, relative

to the Source Energy Design Rating 1 calculated for the Standard Design building.

2. Section (b)(2) is adopted without modification.
3. Section (b)(3) is adopted without modification.

### **15.03.080 Local Amendments to Multifamily Buildings – Mandatory Requirements**

A. Section 160.4 “Mandatory Requirements for Water Heating Systems” of Subchapter 10 is amended to remove subsection (a) as follows:

(a) ~~Reserved. Systems using gas or propane water heaters to serve individual dwelling units shall include the following components:~~

- ~~1. 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, within 3 feet from the water heater and accessible to the water heater with no obstructions. In addition, all of the following:
  - ~~A. Both ends of the unused conductor shall be labeled with the word “spare” and be electrically isolated; and~~
  - ~~B. A reserved single pole circuit breaker space in the electrical panel adjacent to the circuit breaker for the branch circuit in A above and labeled with the words “Future 240V Use”; and~~~~
- ~~2. A Category III or IV vent, or a Type B vent with straight pipe between the outside termination and the space where the water heater is installed; and~~
- ~~3. A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance; and~~
- ~~4. A gas supply line with a capacity of at least 200,000 Btu/hr.~~

Sections (b) to (f) are adopted without amendments.

B. Section 160.9 “Mandatory Requirements for Electric Ready Buildings” of Subchapter 10 is amended to read as follows:

(a) – (c): Subsections 160.9(a) – (c) are adopted without modification.

(d) Individual Heat Pump Water Heater Ready. Systems using gas or propane water heaters to serve individual dwelling units shall include the following components and shall meet the requirements of Section 160.9(f):

1. A dedicated 125 volt, 20 amp electrical receptacle that is connected to the electric panel with a 120/240 volt 3 conductor, copper branch circuit rated

to 30 amps, within 3 feet from the water heater and accessible to the water heater with no obstructions. In addition, all of the following:

- A. Both ends of the unused conductor shall be labeled with the word “spare” and be electrically isolated; and
  - B. A reserved single pole circuit breaker space in the electrical panel adjacent to the circuit breaker for the branch circuit in A above and labeled with the words “Future 240V Use”;
2. A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance,
3. The construction drawings shall indicate the location of the future heat pump water heater. The reserved location shall have minimum interior dimensions of 39”x39”x96”,
4. A ventilation method meeting one of the following:
- A. The designed space reserved for the future heat pump water heater shall have a minimum volume of 700 cubic feet; or
  - B. The designed space reserved for the future heat pump water heater shall vent to a communicating space in the same pressure boundary via permanent openings with a minimum total net free area of 250 square inches so that the total combined volume connected via permanent openings is 700 cu. ft. or larger. The permanent openings shall be:
    - i. Fully louvered doors with fixed louvers consisting of a single layer of fixed flat slats; or
    - ii. Two permanent fixed openings, consisting of a single layer of fixed flat slat louvers or grilles, one commencing within 12 inches from the top of the enclosure and one commencing within 12 inches from the bottom of the enclosure.
  - C. The designed space reserved for the future heat pump water heater shall include two 8” capped ducts, venting to the building exterior:

- i. All ducts, connections and building penetrations shall be sealed.
- ii. Exhaust air ducts and all ducts which cross pressure boundaries shall be insulated to a minimum insulation level of R-6
- iii. Airflow from termination points shall be diverted away from each other.

**(e) Central Heat Pump Water Heater Electric Ready.** Central water heating systems using gas or propane to serve multiple dwelling units shall include the following:

- 1. The system input capacity of the gas or propane water heating system shall be determined as the sum of the input gas or propane capacity of all water heating devices associated with each gas or propane water heating system.
- 2. Space reserved shall include:
  - A. Heat Pump. The minimum space reserved shall include space for service clearances and air flow clearances and shall meet one of the following:
    - i. If the system input capacity of the gas water heating system is less than 200,000 BTU per hour, the minimum space reserved for the heat pump shall be 2.0 square feet per input 10,000 BTU per hour of the gas or propane water heating system, and the minimum linear dimension of the space reserved shall be 48 linear inches.
    - ii. If the system input capacity of the gas water heating system is greater than or equal to 200,000 BTU per hour, the minimum space reserved for the heat pump shall be 3.6 square feet per input 10,000 BTU per hour the gas or propane water heating system, and the minimum linear dimension of the space reserved shall be 84 linear inches.
    - iii. The space reserved shall be the space required for a heat pump water heater system that meets the total

building hot water demand as calculated and documented by the responsible person associated with the project.

B. Tanks. The minimum space reserved shall include space for service clearances and shall meet one of the following:

- i. If the system input capacity of the gas water heating system is less than 200,000 BTU per hour, the minimum space reserved for the storage and temperature maintenance tanks shall be 4.4 square feet per input 10,000 BTU per hour of the gas or propane water heating system.
- ii. If the system input capacity of the gas water heating system is greater than or equal to 200,000 BTU per hour, the minimum physical space reserved for the storage and temperature maintenance tanks shall be 3.1 square feet per input 10,000 BTU per hour of the gas or propane water heating system.
- iii. The space reserved shall be the space required for a heat pump water heater system that meets the total building hot water demand as calculated and documented by the responsible person associated with the project.

3. Ventilation shall be provided by meeting one of the following:

- A. Physical space reserved for the heat pump shall be located outside, or
- B. A pathway shall be reserved for future routing of supply and exhaust air via ductwork from the reserved heat pump location to an appropriate outdoor location. Penetrations through the building envelope for louvers and ducts shall be planned and identified for future use. The reserved pathway and penetrations through the building envelope shall be sized to meet one of the following:
  - i. If the system input capacity of the gas water heating system is less than 200,000 BTU per hour, the minimum air flow rate shall be 70 CFM per input 10,000 BTU per hour of the gas or propane water heating

system and the total external static pressure drop of ductwork and louvers shall not exceed 0.17 inch when the future heat pump water heater is installed.

- ii. If the system input capacity of the gas water heating system is greater than or equal to 200,000 BTU per hour, the minimum air flow rate shall be 420 CFM per input 10,000 BTU per hour of the gas or propane water heating system and the total external static pressure drop of ductwork and louvers shall not exceed 0.17 inch when the future heat pump water heater is installed.
- iii. The reserved pathway and penetrations shall be sized to serve a heat pump water heater system that meets the total building hot water demand as calculated and documented by the responsible person associated with the project.

4. Condensate drainage piping. An approved receptacle that is sized in accordance with the California Plumbing Code to receive the condensate drainage shall be installed within 3 feet of the reserved heat pump location, or piping shall be installed from within 3 feet of the reserved heat pump location to an approved discharge location that is sized in accordance with the California Plumbing Code, and meets one of the following:

- A. If the system input capacity of the gas water heating system is less than 200,000 BTU per hour, condensate drainage shall be sized for 0.2 tons of refrigeration capacity per input 10,000 BTU per hour.
- B. If the system input capacity of the gas water heating system is greater than or equal to 200,000 BTU per hour, condensate drainage shall be sized for 0.7 tons of refrigeration capacity per input 10,000 BTU per hour.
- C. Condensate drainage shall be sized to serve a heat pump water heater system that meets the total building hot water demand as calculated and documented by the responsible person associated with the project.

5. Electrical.

A. Physical space shall be reserved on the bus system of the main switchboard or on the bus system of a distribution board to serve the future heat pump water heater system including the heat pump and temperature maintenance tanks. In addition, the physical space reserved shall be capable of providing adequate power to the future heat pump water heater as follows:

i. Heat Pump. For the Heat Pump, the physical space reserved shall comply with one of the following:

A. If the system input capacity of the gas water heating system is less than 200,000 BTU per hour, provide 0.1 kVA per input 10,000 BTU per hour.

B. If the system input capacity of the gas water heating system is greater than or equal to 200,000 BTU per hour, provide 1.1 kVA per input 10,000 BTU per hour.

C. The physical space reserved supplies sufficient electrical power required to power a heat pump water heater system that meets the total building hot water demand as calculated and documented by the responsible person associated with the project.

ii. Temperature Maintenance Tank. For the Temperature Maintenance Tank, the physical space reserved shall comply with one of the following:

A. If the system input capacity of the gas water heating system is less than 200,000 BTU per hour, provide 1.0 kVA per input 10,000 BTU per hour.

B. If the system input capacity of the gas water heating system is greater than or equal to 200,000 BTU per hour, provide 0.6 kVA per input 10,000 BTU per hour.

C. The physical space reserved supplies sufficient electrical power required to power a heat pump water heater system that meets the total building hot water demand as calculated and documented by the responsible person associated with the project.

(f) The building electrical system shall be sized to meet the future electric requirements of the electric ready equipment specified in sections 160.9 a – e. To meet this requirement the building main service conduit, the electrical system to the point specified in each subsection, and any on-site distribution transformers shall have sufficient capacity to supply full rated amperage at each electric ready appliance in accordance with the California Electric Code.

### **15.03.090 Local Amendments to Multifamily Buildings – Performance and Prescriptive Compliance Approaches**

A. Section 170.1 “Performance Approach” of Subchapter 11 is adopted with amendments as follows:

A building complies with the performance approach if the TDV energy budget calculated for the proposed design building under Subsection (b) is no greater than the TDV energy budget calculated for the Standard Design Building under Subsection (a). Additionally,

1. The energy budget, expressed in terms of source energy, of a newly constructed low-rise multifamily building (three habitable stories or less) shall be at least 7 percent lower than that of the Standard Design Building.

Sub-sections (a) to (d) are adopted without amendments.

### **SECTION 5. SEVERABILITY.**

If any word, phrase, sentence, part, section, subsection, or other portion of this Chapter, or any application thereof to any person or circumstance is declared void, unconstitutional, or invalid for any reason, then such word, phrase, sentence, part, section, subsection, or other portion, or the prescribed application thereof, shall be severable, and the remaining provisions of this Chapter, and all applications thereof, not having been declared void, unconstitutional or invalid, shall remain in full force and effect. The City Council hereby declares that it would have passed this title, and each section, subsection, sentence, clause, and phrase of this Chapter, irrespective of the fact that any one or more sections, subsections, sentences, clauses, or phrases is declared invalid or unconstitutional.

### **SECTION 6. CERTIFICATION.**

The City Clerk shall certify to the adoption of this ordinance and, within 15 days after its adoption, shall cause it to be published in accord with California Law.

**SECTION 7. EFFECTIVE DATE.**

This ordinance shall take effect 30 days following adoption by the City Council.

**INTRODUCED ON** the \_\_\_\_ day of \_\_\_\_\_, 2025.

**PASSED, APPROVED, AND ADOPTED** this \_\_\_\_\_day of \_\_\_\_\_, 2025.

\_\_\_\_\_  
PAULA PEROTTE, MAYOR

**ATTEST:**

**APPROVED AS TO FORM:**

\_\_\_\_\_  
DEBORAH S. LOPEZ  
CITY CLERK

\_\_\_\_\_  
ISAAC ROSEN  
ACTING CITY ATTORNEY

STATE OF CALIFORNIA )  
COUNTY OF SANTA BARBARA ) ss.  
CITY OF GOLETA )

I, Deborah S. Lopez, City Clerk of the City of Goleta, California, do hereby certify that the foregoing Ordinance No. 25-\_\_ was introduced on \_\_\_\_\_, and adopted at a regular meeting of the City Council of the City of Goleta, California, held on the \_\_\_\_\_, by the following roll-call vote, to wit:

AYES:

NOES:

ABSENT:

ABSTENTIONS:

(SEAL)

---

DEBORAH S. LOPEZ  
CITY CLERK

## **ATTACHMENT 2**

### **Memo on Energy Performance Approach for Goleta Reach Code**

## EXECUTIVE SUMMARY

The purpose of this document is to summarize how the Energy Performance approach reach code ordinance provides [Hourly Source Energy](#) compliance margins that are achievable for new construction buildings in Goleta (Climate Zone 6) while meeting two criteria:

- 1) Cost-effective, for approval by the California Energy Commission (CEC).
- 2) Technically feasible, using appliances with efficiencies set at the minimum federal requirements.

The Energy Performance approach encourages new construction buildings to reduce their emissions, and improve outdoor and indoor air quality. This is achieved by requiring new construction buildings utilizing the performance pathway to meet an Hourly Source Energy compliance margin which is stricter than that set by the state in the [2022 Energy Code, Title 24, Part 6](#). The reach codes mitigates legal risk with the Energy Policy and Conservation Act (EPCA) as a result of the [California Restaurant Association vs. City of Berkeley](#) ruling by remaining fuel neutral through providing cost-effective pathways to compliance for both mixed-fuel and all-electric buildings utilizing appliances with efficiencies set at the minimum federal requirements.

**Table 1. Summary of EDR1/Source Energy Compliance Margins and Cost-Effectiveness Data for Climate Zone 6**

| Building Type                    | Metric        | Reach Code Compliance Margin                       | Package      | Package Details   | Achieves Compliance Margin? | Is it Cost-Effective? | Links                                  |
|----------------------------------|---------------|--|--------------|---|-----------------------------|-----------------------|--|
| Single Family                    | EDR1          | 5 or greater                                       | All-electric | Both major appliances are heat pumps (water heating and space heating & cooling) with a market baseline water heater. | Yes                         | Yes                   | <a href="#">Report SFNC Study Data</a> |
|                                  |               |  | Mixed-fuel   | Combustion equipment is used with building efficiency measures, additional PV, and a battery.                         | Yes                         | Yes                   |  |
| Multifamily (3-stories and less) | Source Energy | 7% or greater                                      | All-electric | Both major appliances are heat pumps (water heating and space heating & cooling).                                     | Yes                         | Yes                   | <a href="#">Report MFNC Study Data</a> |
|                                  |               |  | Mixed-fuel   | Combustion equipment is used with building efficiency measures, additional PV, and a battery.                         | Yes                         | Yes                   |  |
| Nonresidential                   | Source Energy | 2% to 14% or greater<br>(depends on building type) | All-electric | Both major appliances are heat pumps (water heating and space heating & cooling).*                                    | Yes*                        | Yes*                  | <a href="#">Report NRNC Study Data</a> |
|                                  |               |  | Mixed-fuel   | Combustion equipment is used with building efficiency measures.   | Yes*                        | Yes*                  |  |

\*Source Energy compliance margins and cost-effectiveness results vary by prototype building, see the nonresidential report for the full set of results in more detail.

# MEMORANDUM

December 19, 2024

To: Dana Murray (Goleta)  
From: Taylor Taylor, Farhad Farahmand (TRC)  
Re: Energy Performance Approach for Goleta Reach Code

## OVERVIEW

TRC provides this memo to direct readers to the references of the Hourly Source Energy margins used in the reach code ordinance. Hourly Source Energy is a compliance metric introduced in 2022 California Building Energy Efficiency Standards representing, among other things, transmission, delivery and production losses from the underlying fuel sources used to power building systems and equipment. A more thorough description of Hourly Source Energy compliance metric and relationship with other metrics is included in this [Energy Code Ace document](#), excerpted at the end of this memo.

Cost-effectiveness studies produced by the [California Investor-Owned Utilities Codes and Standards Program](#) serve as the primary source of information. For various measure packages, these studies demonstrate Hourly Source Energy compliance margins that are achievable for new construction in Goleta (Climate Zone 6) while meeting two criteria:

- 3) Cost-effective, for approval by the California Energy Commission (CEC).
- 4) Technically feasible, using appliances with efficiencies set at the minimum federal requirements.

## Single Family

In single family only, the Hourly Source Energy metric is instead referred to as Energy Design Rating 1 (EDR1). EDR1 margins meeting the two criteria listed above are contained in the 2022 Cost-Effectiveness Study: Single Family New Construction Study ([Report](#)) and workbook ([SFNC Study Data](#)) for a 2,400 square foot single family building. Per Figure 1 below:

- ◆ The All-Electric Code Minimum package achieves an EDR1 margin equal to 4.2 (cell S385).
- ◆ The All-Electric Efficiency package that includes efficiency measures as well as the market baseline heat pump water heater, achieves 5.25 (cell S386).
- ◆ The All-Electric Efficiency + Equipment package that includes efficiency measures as well as the market baseline heat pump water heater (which performs well above federal minimum efficiency requirements), achieves 8.4 (cell S388).
- ◆ The Mixed Fuel Efficiency, PV, + Battery package achieves 18.3 (cell S391).

An **EDR1 compliance margin of 5** reflects a cost-effective baseline achievable by an all-electric new construction single family building with a market baseline water heater, that is also technically feasible by a mixed-fuel building with appliances efficiencies at minimum federal requirements.

|     | F  | H            | I                  | S                |
|-----|--|--------------|--------------------|------------------|
| 6   | measure                                      | fuel_type    | baseline_fuel_type | EDR1total_margin |
| 885 | All-Electric Code Minimum                    | All Electric | Mixed-fuel         | 4.2              |
| 886 | All-Electric Efficiency                      | All Electric | Mixed-fuel         | 5.25             |
| 888 | All-Electric Efficiency + PV                 | All Electric | Mixed-fuel         | 8.4              |
| 891 | Mixed Fuel Efficiency, PV, + Battery (Basic) | Mixed-fuel   | Mixed-fuel         | 18.3             |

Figure 1. Single Family (2400 square foot prototype) source energy margin results

### Small Homes

Information on small new construction single family homes, such as ADUs, can also be found in the single-family home sources listed above by filtering for the 625 square foot single family building. Single family homes that are less than 1,500 square feet can have difficulties meeting the margins listed above for single family homes. This is because smaller homes use less energy overall and therefore the amount of energy savings potential is diminished. In order to prevent frequent cases of technical infeasibility, an exception is offered for homes less than 1,500 square foot, set at the target where a 625 square foot home can achieve it. Per Figure 2 below:

- ◆ The All-Electric Code Minimum package achieves an EDR1 margin equal to 0.5 (cell S105).
- ◆ The All-Electric Efficiency package that includes efficiency measures, achieves 1.3 (cell S106).
- ◆ The All-Electric Efficiency + High Efficiency Equipment package that includes efficiency measures as well as the market baseline heat pump water heater (which performs well above federal minimum efficiency requirements), achieves 2.6 (cell S107).
- ◆ The All-Electric Efficiency + PV package achieves 5.0 (cell S108).
- ◆ The Mixed Fuel Efficiency + High Efficiency Equipment package achieves 1.8 (cell S110).
- ◆ The Mixed Fuel Efficiency, PV, + Battery package achieves 19.8 (cell S111).

The all-electric efficiency + PV package is cost-effective and achieves an EDR1 of 5.0. Therefore, a small homes reach code compliance margin could be set as high as 5.0. The margin can be set lower, **such as at a compliance margin of 2**, to align with an all-electric building with a market baseline water heater, and also with the all-electric efficiency package. This encourages emissions reductions while reducing construction cost burden on smaller sized homes.

|     | F   | H            | I                  | S                |
|-----|---|--------------|--------------------|------------------|
| 6   | measure   | fuel_type    | baseline_fuel_type | EDR1total_margin |
| 105 | All-Electric Code Minimum                           | All Electric | Mixed-fuel         | 0.5              |
| 106 | All-Electric Efficiency                             | All Electric | Mixed-fuel         | 1.3              |
| 107 | All-Electric Efficiency + High Efficiency Equipment | All Electric | Mixed-fuel         | 2.6              |
| 108 | All-Electric Efficiency + PV                        | All Electric | Mixed-fuel         | 5.0              |
| 110 | Mixed Fuel Efficiency + High Efficiency Equipment   | Mixed-fuel   | Mixed-fuel         | 1.8              |
| 111 | Mixed Fuel Efficiency, PV, + Battery (Basic)        | Mixed-fuel   | Mixed-fuel         | 19.8             |

Figure 2. Single Family (625 square foot prototype) source energy margin results

## Multifamily

Hourly Source Energy margins meeting the two criteria listed above are contained in the 2022 Cost-Effectiveness Study:

Multifamily New Construction ([Report](#)) and workbook ([MFNC Study Data](#)) for two multifamily family buildings (3-story, 39,372 ft<sup>2</sup> and 5-story, 140,925 ft<sup>2</sup>). Per Figure 3 below:

- ◆ For the 3-story prototype
  - ◆ The All-Electric Code Minimum package achieves an Hourly Source Energy margin equal to 7% (cell AI76).
  - ◆ The Mixed Fuel Efficiency, PV, + Battery package achieves 18% (cell AI105)
- ◆ For the 5-story prototype
  - ◆ The All-Electric Code Minimum package achieves an Hourly Source Energy margin of 5% (cell AI107).
  - ◆ The Mixed Fuel Efficiency + PV package achieves 0% (cell AI160)

An **Hourly Source Energy compliance margin of 7% for 3-stories and less, and 0% for 4-stories and more**, reflects a cost-effective baseline achievable by an all-electric code minimum new construction multifamily building, that is also technically feasible by a mixed-fuel building with appliances efficiencies at minimum federal requirements.

|     | E         | F                                    | H            | I                  | AI                         |
|-----|-----------|--------------------------------------|--------------|--------------------|----------------------------|
|     | prototype | measure                              | fuel_type    | baseline_fuel_type | Total Source Energy Margin |
| 5   | ▼         |                                      | ▼            | ▼                  | ▼                          |
| 55  | 39372     | all-electric prescriptive & PV       | All Electric | Mixed-fuel         | 17%                        |
| 76  | 39372     | all-electric prescriptive            | All Electric | Mixed-fuel         | 7%                         |
| 105 | 39372     | mixed fuel efficiency & PV & battery | Mixed-fuel   | Mixed-fuel         | 18%                        |
| 106 | 140925    | all-electric prescriptive & PV       | All Electric | Mixed-fuel         | 12%                        |
| 107 | 140925    | all-electric prescriptive            | All Electric | Mixed-fuel         | 5%                         |
| 160 | 140925    | mixed fuel efficiency & PV           | Mixed-fuel   | Mixed-fuel         | 0%                         |

**Figure 3. Multifamily source energy results.** Under the “prototype” column, the 3-story building is 39,372 ft<sup>2</sup> and the 5-story building is 140,925 ft<sup>2</sup>.

## Nonresidential

Hourly Source Energy margins meeting the two criteria listed above are contained in the 2022 Nonresidential New Construction Reach Code Cost-effectiveness Study ([Report](#)) and workbook ([NRNC Study Data](#)) for four nonresidential prototypes (Medium Office, Retail, Quick-Service Restaurant, and Small Hotel). Per Figure 4 below:

- ◆ For the Medium Office (‘MO’ tab in the workbook)
  - ◆ The All-Electric Code Minimum package achieves an Hourly Source Energy margin equal to 3% (cell T33).
  - ◆ The Mixed Fuel + Efficiency package achieves 14% (cell T10).
- ◆ For the Medium Retail (‘RE’ tab in the workbook)
  - ◆ The Mixed Fuel Code Minimum package achieves -22% (cell T10).
  - ◆ The All-Electric + Efficiency package achieves 16% (cell T56).
- ◆ For the Quick Service Restaurant (‘QSR’ tab in the workbook)
  - ◆ The All-Electric Code Minimum package achieves 35% (cell T125).
  - ◆ The Mixed Fuel + Efficiency package achieves 2% (cell T10).
- ◆ For the Small Hotel (‘SH’ tab in the workbook)
  - ◆ The All-Electric Code Minimum package achieves 27% (cell T33).

- ◆ The Mixed Fuel + Efficiency package achieves 7% (cell T10).

For nonresidential buildings, an Hourly Source Energy compliance margin of at least the following is required:

- Hotels – 7%
- Small Restaurants – 2%
- Offices – 14%
- All Other Nonresidential Building Types – 7%

This reflects the performance of mixed-fuel buildings with appliances efficiencies at minimum federal requirements and additional non-preemptive efficiency measures. Nonresidential buildings with all-electric heat pumps at minimum federal requirements will achieve this target without any additional efficiency measures, besides office buildings, which will include additional efficiency measures with all-electric heat pumps to be utilized.

A subset of nonresidential buildings which utilize small rooftop HVAC, like Retail, already have heat pump as the prescriptive code minimum, which achieves the same objective as the reach code applied to the nonresidential buildings. To account for this, an exception is included for nonresidential buildings that reduces the Hourly Source Energy compliance margin to 0% (the state minimum requirement) when nonresidential occupancies are designed with single zone space-conditioning systems complying with Section 140.4(a)2.

|    | B           | T                          |    | B          | T                          |     | B              | T                          |     | B            | T                          |
|----|-------------|----------------------------|----|------------|----------------------------|-----|----------------|----------------------------|-----|--------------|----------------------------|
| 2  | Package     | Source kBtu Margin (CBECC) | 2  | Package    | Source kBtu Margin (CBECC) | 2   | Package        | Source kBtu Margin (CBECC) | 2   | Package      | Source kBtu Margin (CBECC) |
| 10 | mo-mf-eff   | 14%                        | 10 | re-mf-code | -22%                       | 10  | qsr-mf-eff     | 2%                         | 10  | sh-mf-eff    | 7%                         |
| 33 | mo-ae-code  | 3%                         | 33 | re-mf-eff  | -1%                        | 33  | qsr-ae-hs      | 30%                        | 33  | sh-ae-code   | 27%                        |
| 56 | mo-ae-eff   | 14%                        | 56 | re-ae-eff  | 16%                        | 56  | qsr-ae-hseff   | 43%                        | 56  | sh-ae-eff    | 10%                        |
| 79 | mo-ae-efflf | 26%                        | 79 |            |                            | 79  | qsr-ae-hsefflf | 49%                        | 79  | sh-ae-effpv  | 23%                        |
|    |             |                            |    |            |                            | 102 | qsr-ae-hseffpv | 52%                        | 102 | sh-ae-codept | 27%                        |
|    |             |                            |    |            |                            | 125 | qsr-ae-code    | 35%                        |     |              |                            |
|    |             |                            |    |            |                            | 148 | qsr-ae-eff     | 46%                        |     |              |                            |

Figure 4. Source energy margin results for Medium Office (MO), Retail (RE), Quick Service Restaurant (QSR), and Small Hotel (SH)

## Appendix: Single Family Building Summary of Source Energy and Other Metrics

### Evolving Compliance Metrics

The 2022 Energy Code continues improvements in energy efficiency ratings in order to pivot new residential buildings toward technologies that will help the state meet its critical long-term climate and carbon neutrality goals.

| Energy Code  | New Construction  | Additions | Alterations |
|--|-------------------|-----------|-------------|
| 2016   | TDV               | TDV       | TDV         |
| 2019   | EDRe, EDRT        | TDV       | TDV         |
| 2022   | EDRs*, EDRe, EDRT | TDV       | TDV         |
| <b>EDRs = source energy design; EDRe = efficiency energy design rating; EDRT = total energy design rating; TDV = time dependent valuation.</b><br>The source EDR metric is new for 2022 and enables measure of emissions in some form. |                   |           |             |

**Table 1.** Evolving Building Energy Efficiency Ratings for Residential Construction

The 2016 Energy Code used time dependent valuation (TDV) energy as a compliance metric in the Performance Approach for New Construction, Additions and Alterations. TDV energy is the time varying energy used by the building to provide space conditioning, water heating and specified building lighting. It accounts for the energy used at the building site and consumed in producing and delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses.

The 2019 Energy Code replaced TDV with energy design rating (EDR) metrics for New Construction to express the energy performance of a home. In the EDR scoring system 100 represents the energy performance of a reference design building meeting the envelope requirements of the 2006 International Energy Conservation Code (IECC). A score of 0 represents the energy consumption of a building that has zero net energy consumption. The lower the score, the better. For a New Construction project to comply using the performance approach, the proposed Efficiency EDR and Total EDR must be lower than or equal to the standard Efficiency EDR and Total EDR.

The 2022 Energy Code adds a third metric to EDR for New Construction: source energy design rating ERD1 is a separate EDR metric based on hourly source energy which establishes a carbon-proxy analysis of the building in kBtu/sf-yr units to support decarbonization and electrification policy goals.

| Source Energy Design Rating (EDR1)   | Efficiency Energy Design Rating (EDR2)   | Total Energy Design Rating (EDR Total)   |
|--|--|--|
| A score representing the building energy efficiency expressed in terms of an <b>hourly source carbon-based metric</b>                        | A score representing the building energy efficiency expressed in terms of a <b>TDV energy-based metric</b> | A score representing the building's <b>total TDV energy while also factoring in photovoltaics (PV) and flexibility</b> |
| EDR1 includes:<br>+ Envelope<br>+ IAQ<br>+ HVAC<br>+ DHW<br>+ Unregulated loads  | EDR2 includes:<br>+ Envelope<br>+ IAQ<br>+ HVAC<br>+ DHW<br>+ Unregulated loads                            | EDR Total includes:<br>+ Efficiency measures<br>+ Photovoltaics<br>+ Batteries<br>+ Precooling                         |
| <b>DHW = domestic hot water; HVAC = heating, ventilation and air conditioning; IAQ = indoor air quality; TDV = time dependent valuation.</b> |  |  |

**Table 2.** Energy Design Rating (EDR) as a Compliance Metric

A building complies only if all three compliance scores are met, which means that each proposed design score is lower than or equal to the standard design score.

Source: [Energy Code Ace – Single Family Buildings: What’s New in 2022?](#)

## **ATTACHMENT 3**

### **2022 Cost Effectiveness Studies (Multifamily, Single-family, Non-residential)**

# 2022 Cost-Effectiveness Study: Multifamily New Construction

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### 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

CFI – California Flexible Installation

CFM – Cubic Feet per Minute

CO<sub>2</sub> – Carbon Dioxide

CPAU – City of Palo Alto Utilities

CPUC – California Public Utilities Commission

CZ – California Climate Zone

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

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 – kilo-British thermal unit

kWh – Kilowatt Hour

LBNL – *Lawrence Berkeley National Laboratory*

LCC – Lifecycle Cost

LLAHU – Low Leakage Air Handler Unit

VLLDCS – Verified Low Leakage Ducts in Conditioned Space

MF – Multifamily

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

ZNE – Zero-net Energy

| Summary of Revisions |  |                             |
|----------------------|--|-----------------------------|
| Date                 | Description                                      | Reference (page or section) |
| 2/28/2022            | Original Release                                 | N/A                         |
| 6/20/2023            | Minor revisions to content; no change to results | 2, 3, 32, 33                |
|                      |  |                             |

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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 combinations of measures that exceed the minimum state requirements, the 2022 Building Energy Efficiency Standards (Title 24, Part 6 or Energy Code), effective January 1, 2023, for newly constructed multifamily buildings. The analysis considers low-rise and mid-rise multifamily building types and evaluates mixed fuel and all-electric package options in all sixteen California climate zones (CZs). Packages include a code compliant electrification package and a mixed fuel efficiency package, as well as the addition of above-code on-site solar photovoltaic (PV) capacity and battery energy storage. The 2022 Energy Code established electric heat pumps as the prescriptive baseline for space heating in most climate zones. As a result, this analysis primarily focuses on the electrification of central water heating. Space heating electrification was also evaluated where the prescriptive heat pump baseline didn't apply: In Climate Zone 16 for multifamily buildings three habitable stories or fewer, and Climate Zones 1 and 16 for multifamily buildings greater than three habitable stories.

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. Time Dependent Valuation (TDV) is the California Energy Commission's LCC methodology, 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, Part 6.

Two multifamily prototypes were evaluated in this study. A 3-story loaded corridor and a 5-story mixed use prototype, which combined are estimated to represent 91 percent of new multifamily construction in California.

The following summarizes key results from the study:

- The Reach Codes Team found all-electric new construction to be feasible and cost-effective based on the California Energy Commission's Time Dependent Valuation (TDV) metric in all cases. In many cases all-electric prescriptive code construction results in an increase in utility costs and is not cost-effective On-Bill. Some exceptions include the SMUD and CPAU territories where lower electricity rates relative to gas rates result in lower overall utility bills.
- All-electric packages have lower GHG emissions than mixed fuel packages in all cases, due to the clean power sources currently available from California's power providers.
- The 2022 Energy Code's new source energy metric combined with the heat pump space heating baseline in most climate zones encourages all-electric construction. While the code does not include an electric baseline for water heating, the penalty for central electric water heating observed in the performance approach in past code cycles has been removed and a credit is provided for well-designed central heat pump water heaters in most cases.
- Electrification combined with increased PV capacity results in utility cost savings and was found to be On-Bill cost-effective in all cases.
- The results in this study are based on today's net energy metering (NEM 2.0) rules and do not account for recently approved changes to the NEM tariff (referred to as the net billing tariff). The net billing tariff decreases the value of PV to the consumer as compared to NEM 2.0. As a result, the cost-effectiveness of the packages that include above-code PV capacity is expected to be less under the net billing tariff. Conversely, the net

billing tariff is expected to increase On-Bill cost-effectiveness of the all-electric prescriptive code scenario. An all-electric home has better on-site utilization of generated electricity from PV than a mixed fuel home with a similar sized PV system, and as a result exports less electricity to the grid. Since the net-billing tariff values exports less than under NEM 2.0, the relative impact on annual utility costs to the mixed fuel baseline is greater.

- This analysis does justify a modest reach based on either efficiency TDV or source energy for all-electric buildings. However, this may be challenging for some projects given the recent changes to which the industry must adapt, including the efficiency updates and multifamily restructuring in the 2022 Title 24, Part 6 code. While project compliance margins using a CO<sub>2</sub> refrigerant heat pump water heating system are high, the Reach Code Team found lower compliance margins using other heat pump water heater system designs. Focusing on supporting projects to electrify water heating is expected to support the market shift towards more central heat pump water heaters.
- For jurisdictions interested in a reach code that allows for mixed fuel buildings, a mixed fuel efficiency and PV package (and battery for the 3-story prototype) was found to be cost-effective based on TDV in all cases and cost-effective On-Bill in most climate zones. This path, referred to as “Electric-Preferred”, allows for mixed fuel buildings but requires a higher building performance than for all-electric buildings. The efficiency measures evaluated in this study did not provide significant compliance benefit. As a result, the Reach Codes Team recommends establishing a compliance margin target based on source energy or total TDV. This would allow for PV and battery above minimum code requirements to be used to meet the target.
- Jurisdictions interested in increasing affordable multifamily housing should know that applying the CARE rates has the overall impact of increasing utility cost savings for an all-electric building in most climate zones compared to a code compliant mixed fuel building, improving On-Bill cost-effectiveness.

Table ES-1 summarizes results for each prototype and depicts the efficiency TDV compliance margins achieved for each climate zone and package. All results presented in the table have a positive compliance margin (greater than zero percent). Cells highlighted in **green** depict cases with a positive compliance margin and cost-effective results using both On-Bill and TDV approaches. Cells highlighted in **yellow** depict cases with a positive compliance margin and cost-effective results using either the On-Bill or TDV approach. Cells **not highlighted** depict cases with a positive compliance margin but that were not cost-effective using either the On-Bill or TDV approach.

**Table ES-1. Summary of Efficiency TDV Compliance Margins and Cost-Effectiveness**

| Climate Zone | Electric /Gas Utility | 3-Story                        |                   |                       |                                      | 5-Story                        |                   |                       |                            |
|--------------|-----------------------|--------------------------------|-------------------|-----------------------|--------------------------------------|--------------------------------|-------------------|-----------------------|----------------------------|
|              |                       | All-Electric Prescriptive Code | All-Electric + PV | Mixed Fuel Efficiency | Mixed Fuel Efficiency + PV + Battery | All-Electric Prescriptive Code | All-Electric + PV | Mixed Fuel Efficiency | Mixed Fuel Efficiency + PV |
| CZ01         | PGE                   | 26%                            | 26%               | 1%                    | 1%                                   | 14%                            | 14%               | 0%                    | 0%                         |
| CZ02         | PGE                   | 20%                            | 20%               | 1%                    | 1%                                   | 9%                             | 9%                | 1%                    | 1%                         |
| CZ03         | PGE                   | 21%                            | 21%               | 1%                    | 1%                                   | 11%                            | 11%               | 0%                    | 0%                         |
| CZ04         | PGE                   | 18%                            | 18%               | 1%                    | 1%                                   | 9%                             | 9%                | 1%                    | 1%                         |
| CZ04         | CPAU                  | 18%                            | 18%               | 1%                    | 1%                                   | 9%                             | 9%                | 1%                    | 1%                         |
| CZ05         | PGE                   | 23%                            | 23%               | 1%                    | 1%                                   | 12%                            | 12%               | 0%                    | 0%                         |
| CZ05         | PGE/SCG               | 23%                            | 23%               | 1%                    | 1%                                   | 12%                            | 12%               | 0%                    | 0%                         |
| CZ06         | SCE/SCG               | 18%                            | 18%               | 1%                    | 1%                                   | 9%                             | 9%                | 0%                    | 0%                         |
| CZ07         | SDGE                  | 20%                            | 20%               | 0%                    | 0%                                   | 11%                            | 11%               | 0%                    | 0%                         |
| CZ08         | SCE/SCG               | 13%                            | 13%               | 1%                    | 1%                                   | 8%                             | 8%                | 1%                    | 1%                         |
| CZ09         | SCE                   | 13%                            | 13%               | 1%                    | 1%                                   | 7%                             | 7%                | 1%                    | 1%                         |
| CZ10         | SCE/SCG               | 14%                            | 14%               | 3%                    | 3%                                   | 7%                             | 7%                | 2%                    | 2%                         |
| CZ10         | SDGE                  | 14%                            | 14%               | 3%                    | 3%                                   | 7%                             | 7%                | 2%                    | 2%                         |
| CZ11         | PGE                   | 14%                            | 14%               | 3%                    | 3%                                   | 8%                             | 8%                | 2%                    | 2%                         |
| CZ12         | PGE                   | 17%                            | 17%               | 2%                    | 2%                                   | 9%                             | 9%                | 2%                    | 2%                         |
| CZ12         | SMUD/PGE              | 17%                            | 17%               | 2%                    | 2%                                   | 9%                             | 9%                | 2%                    | 2%                         |
| CZ13         | PGE                   | 13%                            | 13%               | 4%                    | 4%                                   | 7%                             | 7%                | 2%                    | 2%                         |
| CZ14         | SCE/SCG               | 13%                            | 13%               | 3%                    | 3%                                   | 6%                             | 6%                | 2%                    | 2%                         |
| CZ14         | SDGE                  | 13%                            | 13%               | 3%                    | 3%                                   | 6%                             | 6%                | 2%                    | 2%                         |
| CZ15         | SCE/SCG               | 5%                             | 5%                | 5%                    | 5%                                   | 3%                             | 3%                | 3%                    | 3%                         |
| CZ16         | PG&E                  | 24%                            | 24%               | 5%                    | 5%                                   | 9%                             | 9%                | 2%                    | 2%                         |

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. Reach codes that amend Part 6 of the CA Building Code and require energy performance (including PV and storage) beyond state code minimums must demonstrate that the proposed changes are cost-effective and obtain approval from the Energy Commission prior to filing with the BSC.

Model ordinance language and other resources are posted on the C&S Reach Codes Program website at [LocalEnergyCodes.com](https://localenergycodes.com). Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at [info@localenergycodes.com](mailto:info@localenergycodes.com).

# 1 Introduction

This report documents cost-effective combinations of measures that exceed the minimum state requirements, the 2022 Building Energy Efficiency Standards, effective January 1, 2023, for newly constructed multifamily buildings. This report was developed in coordination with the California Statewide Investor-Owned Utilities (CA IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Reach Codes Team. The CA IOU Codes and Standards Program is comprised of IOUs 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 analysis considers low-rise and mid-rise multifamily building types and evaluates mixed fuel and all-electric package options in all sixteen California climate zones (CZs)<sup>1</sup> Packages include combinations of efficiency measures, on-site renewable energy, and battery energy storage.

The California Building Energy Efficiency Standards Title 24, Part 6 (Energy Code) (California Energy Commission, 2022a) is maintained and updated every three years by two state agencies: the California Energy Commission (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 (California Energy Commission, 2022a)). 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 measures 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.

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<sup>1</sup> See Appendix 7.1 Map of California Climate Zones for a graphical depiction of climate zone locations.

## 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 software approved for 2022 Title 24 Code compliance analysis, CBECC 2022.2.0.

Using the 2022 baseline as the starting point, prospective energy efficiency measures were identified and modeled to determine the projected site energy (therm and kWh) and compliance impacts. Annual utility costs were calculated using hourly data output from CBECC, and electricity and natural gas tariffs for each of the investor-owned utilities (IOUs).

This analysis focused on residential apartments only (a prior study and report analyzed the cost-effectiveness of above code packages for nonresidential buildings (Statewide Reach Codes Team, 2022b). The Statewide Reach Codes Team selected measures for evaluation based on the single family 2022 reach code analysis (Statewide Reach Codes Team, 2022a) and the multifamily 2019 reach code analysis [ (Statewide Reach Codes Team, 2020), (Statewide Reach Codes Team, 2021)] as well as experience with and outreach to architects, builders, and engineers.

#### 2.1.2 Cost-Effectiveness

##### 2.1.2.1 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 manner in which they value energy and thus the cost savings of reduced or avoided energy use:

**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 and energy cost inflation.

**Time Dependent Valuation (TDV):** This 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 long-term projected costs, such as the cost of providing energy during peak periods of demand, costs for carbon emissions, and grid transmission and distribution impacts. This metric values energy use differently depending on the fuel source (natural gas, electricity, and propane), time of day, and season. Electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods due to the less inefficient energy generation sources providing peak electricity (Hori, Cutter, Kapur, Arent, & Conotyannis, 2014). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in the 2022 Energy Code.

##### 2.1.2.2 Costs

The Reach Codes Team assessed the incremental costs of the measures and packages over a 30-year lifecycle. Incremental costs represent the equipment, installation, replacements, and maintenance costs of the proposed measure relative to the 2022 Energy Code minimum requirements or standard industry practices. Present value of replacement cost is included for measures with lifetimes less than the evaluation period.

##### 2.1.2.3 Metrics

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

**NPV:** The lifetime NPV is reported as a cost-effectiveness metric, Equation 1 demonstrates how this is calculated. If the NPV of a measure or package is positive, it is considered cost-effective. A negative values represent net costs.

**B/C Ratio:** This is the ratio of the present value (PV) of all benefits to the present value of all costs over 30 years (PV benefits divided by PV costs). The criteria benchmark for cost-effectiveness is a B/C ratio greater than one. 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

$$NPV = PV \text{ of lifetime benefit} - PV \text{ of lifetime cost}$$

### Equation 2

$$\text{Benefit} - \text{to} - \text{Cost Ratio} = \frac{PV \text{ of lifetime benefit}}{PV \text{ of lifetime cost}}$$

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 TDV savings, and the cost is represented by incremental first cost and replacement costs. 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), B/C ratio cost-effectiveness is represented by “>1”.

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

### Equation 3

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

Where:

- $n$  = analysis term in years
- $r$  = discount rate

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

- Analysis term of 30 years
- Real discount rate of three percent

TDV is a normalized monetary format and there is a unique procedure for calculating the present value benefit of TDV energy savings. The present value of the energy cost savings in dollars is calculated by multiplying the TDV savings (reported by the CBECC simulation software) by a NPV factor developed by the Energy Commission (see E3’s 2022 TDV report for details (Energy + Environmental Economics, 2020)). The 30-year residential NPV factor is \$0.173/kTDV for the 2022 Energy Code.

### Equation 4

$$TDV \text{ PV of lifetime benefit} = TDV \text{ energy savings} * NPV \text{ factor}$$

## 2.1.3 Utility Rates

In coordination with the CA IOU rate team (comprised of representatives from PG&E, SCE, SDG&E, SMUD, and CPAU), the Reach Codes Team determined appropriate utility rates for each climate zone in order to calculate utility costs and determine On-Bill cost-effectiveness for the proposed measures and packages. The utility tariffs, summarized in Table 1, were determined based on the most prevalent active rate 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 the IOUs in-unit gas was evaluated under the G1 rate and central gas for water heating was evaluated under the relevant master metered gas tariff, GM. Electricity use for central water heating was evaluated using the residential TOU rates. The water heating utility bill was calculated separately from the in-unit electricity bill. Photovoltaic (PV) and battery energy storage benefits were applied according to virtual net energy metering (VNEM) rules.<sup>2</sup> PV was first assigned to the central water heating meter to offset 100 percent of the electricity use. The remaining PV and all of the battery impacts were then split evenly across the apartment meters. The same approach was applied for CPAU and SMUD using the rates described in Table 1.

The multifamily prototypes used in this analysis include common area spaces that serve the residents (lobby, leasing office, corridors, etc.). Most of the energy use for these spaces could not be separated from that for the dwelling units within the CBECC model. As a result, average per dwelling unit hourly energy use was calculated to include both the dwelling unit and common space energy use.

First-year utility costs were calculated using hourly electricity and natural gas output from CBECC and applying the utility tariffs summarized in Table 1. Annual costs were also estimated for customers eligible for the CARE tariff discounts on both electricity and natural gas bills. The CARE tariff was only applied to the in-unit apartment meters. Appendix 7.2 Utility Rate Schedules includes details of each utility tariff.

For cases with PV generation, the approved NEM 2.0 tariffs were applied along with minimum daily use billing and mandatory non-bypassable charges. In December the California Public Utilities Commission (CPUC) issued a decision adopting a net billing tariff (NBT) as a successor to NEM 2.0 that will go into effect April of 2023<sup>3</sup> Given the recent timing of this decision there was not time to incorporate these changes into this analysis. The Reach Codes Team conducted a limited sensitivity analysis on the impacts of NBT relative to NEM 2.0 on utility bills. It was found that utility costs will increase for all homes with PV systems; however, the increase was less for an all-electric building compared to a mixed fuel building with a similarly sized PV system. As a result of better onsite utilization of PV generation and thus fewer exports to the grid, the Reach Codes Team expects the cost-effectiveness for the electrification scenarios for the all-electric home evaluated in this report to improve under NBT. Conversely, cost-effectiveness of increasing PV capacity is expected to be reduced under NBT.

<sup>2</sup> PG&E: [https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC\\_SCHEDS\\_NEM2V.pdf](https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_SCHEDS_NEM2V.pdf)

SDG&E: [https://tariff.sdge.com/tm2/pdf/tariffs/ELEC\\_ELEC-SCHEDS\\_NEM-V-ST.pdf](https://tariff.sdge.com/tm2/pdf/tariffs/ELEC_ELEC-SCHEDS_NEM-V-ST.pdf)

SCE:

<https://edisonintl.sharepoint.com/teams/Public/TM2/Shared%20Documents/Forms/AllItems.aspx?ga=1&id=%2Fteams%2FPublic%2FTM2%2FShared%20Documents%2FPublic%2FRegulatory%2FTariff%2DSCE%20Tariff%20Books%2FElectric%2FSchedules%2FOther%20Rates%2FELECTRIC%5FSCHEDULES%5FNEM%2DV%2DST%2Epdf&parent=%2Fteams%2FPublic%2FTM2%2FShared%20Documents%2FPublic%2FRegulatory%2FTariff%2DSCE%20Tariff%20Books%2FElectric%2FSchedules%2FOther%20Rates>

<sup>3</sup> <https://www.cpuc.ca.gov/nemrevisit>

**Table 1. Utility Tariffs Used Based on Climate Zone**

| Climate Zones   | Electric / Gas Utility | Electricity  | Natural Gas  |
|-----------------|------------------------|--|--|
| <b>IOUs</b>     |                        |  |  |
| 1-5,11-13,16    | PG&E / PG&E            | E-TOU Option C                                       | G1 (in-unit) & GM (central water heating) <sup>1</sup> |
| 5               | PG&E / SoCalGas        | E-TOU Option C                                       | GM   |
| 6, 8-10, 14, 15 | SCE / SoCalGas         | TOU-D Option 4-9                                     | GM   |
| 7, 10, 14       | SDG&E / SDG&E          | TOU-DR-1   | GM   |
| <b>POUs</b>     |                        |  |  |
| 4               | CPAU / CPAU            | E-1 (in-unit) & E-2 (central water heating)          | G-2  |
| 12              | SMUD / PG&E            | R-TOD, RT02 (in-unit) & RSMM (central water heating) | GM   |

<sup>1</sup>G1 rate applied to gas use within the apartment units, which only occurs in Climate Zones 1 and 16, see Section 3 for details. GM rate applied to gas use for central water heating.

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. See Appendix 7.2.7 Fuel Escalation Assumptions for details.

## 2.2 2022 T24 Compliance Metrics

2022 Title 24, Part 6 Section 170.1 defines the energy budget of the building based on source energy and TDV energy for space-conditioning, indoor lighting, mechanical ventilation, PV and battery storage systems, service water heating and covered process loads. In 2022, the Energy Commission introduced the new compliance metric of source energy, which differs by fuel source (as does TDV) and is a reasonable proxy for greenhouse gas emissions. Additionally, for multifamily buildings four habitable stories and higher prescriptive requirements for PV and battery systems were also introduced. This led to the need to differentiate an efficiency compliance metric, which ensured that the building met minimum efficiency standards, and a total energy compliance metric which incorporated the PV and battery standards. In order to be compliant with the building code a building needs to comply with all three compliance metrics described below:

- **Efficiency TDV.** Efficiency TDV accounts for all regulated end-uses but does not include the impacts of PV and battery storage.
- **Total TDV.** Total TDV includes regulated end-uses and accounts for PV and battery storage contributions.
- **Source Energy.** Source energy is based on fuel used for power generation and distribution.

## 2.3 Greenhouse Gas Emissions

The analysis reports the greenhouse gas (GHG) emission estimates based on assumptions within CBECC. There are 8,760 hourly multipliers accounting for time dependent energy use and carbon based on source emissions, including renewable portfolio standard projections. There are two series of multipliers—one for Northern California climate zones, and another for Southern California climate zones.<sup>4</sup> GHG emissions are reported as average annual metric tons of CO<sub>2</sub> equivalent over the 30-year building lifetime.

<sup>4</sup> CBECC multipliers are the same for CZs 1-5 and 11-13 (Northern California), while there is another set of multipliers for CZs 6-10 and 14-16 (Southern California).

## 3 Prototypes, Measure Packages, and Costs

This section describes the prototypes, measures, costs, and the scope of analysis drawing from previous reach code research where appropriate.

### 3.1 Prototype Characteristics

The Energy Commission defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. There are 4 multifamily prototypes used in code development: a 2-story garden style, a 3-story loaded corridor, a 5-story mixed use and a 10-story mixed use. Based on work completed for the 2022 Title 24 code development, the 3-story and the 5-story represent 33 percent and 58 percent, respectively, of new multifamily construction in California. As a result, these two prototypes are used in this analysis. Additional details on all four prototypes can be found in the Multifamily Prototypes Report (TRC, 2019).

Table 2 describes the basic characteristics of each prototype.

**Table 2. Prototype Characteristics**

| Characteristic            | 3-Story Loaded Corridor                             | 5-Story Mixed Use   |
|---------------------------|---|---|
| Conditioned Floor Area    | 39,372 ft <sup>2</sup>                              | 113,100 ft <sup>2</sup> total:<br>33,660 ft <sup>2</sup> nonresidential<br>79,440 ft <sup>2</sup> residential                 |
| Num. of Stories           | 3   | 6 Stories total:<br>1 story parking garage (below grade)<br>1 story of nonresidential space<br>4 stories of residential space |
| Num. of Bedrooms          | (6) Studio<br>(12) 1-bed<br>(12) 2-bed<br>(6) 3-bed | (8) studios<br>(40) 1-bed units<br>(32) 2-bed units<br>(8) 3-bed units  |
| Window-to-Wall Area Ratio | 25%   | 25%   |
| Wall Type                 | Wood framed   | Wood frame over a first-floor concrete podium   |
| Roof Type                 | Flat roof   | Flat roof   |
| Foundation                | Slab-on-grade                                       | Concrete podium with underground parking  |

The methodology used in the analyses for each of the prototypical building types begins with a design that precisely meets the minimum 2022 prescriptive requirements.<sup>5</sup> Table 170.2-A and 170.2-B in the 2022 Standards (California Energy Commission, 2022a) list the prescriptive measures that determine the baseline design in each climate zone. Other features are designed to meet, but not exceed, the minimum requirements and are consistent with the Standard Design in the ACM Reference Manual (California Energy Commission, 2022c). The analysis also assumed electric resistance cooking in the apartment units to reflect current market data. The 3-story building prototype includes a central laundry facility, and the 5-story assumes laundry in the units. Laundry equipment was assumed to be electric in all cases; electrification of laundry equipment was not addressed in this study. The nonresidential 2022 reach code analysis (Statewide Reach Codes Team, 2022b) did consider electrification of central laundry facilities within the small hotel prototype.

Table 3 describes characteristics as they were applied to the base case energy model in this analysis. In a shift from the 2019 Standards, the 2022 Standards define a prescriptive fuel source for space heating establishing an electric

<sup>5</sup>Due to planned software updates to how the prescriptive requirements are applied in the Standard Design and challenges for certain space types with sizing heating and cooling equipment the same in the Proposed Design as in the Standards, the results compliance margins for the base case models were not exactly zero percent..

heat pump baseline in all climate zones except 16 for multifamily buildings three habitable stories and fewer and 1 and 16 for multifamily buildings four habitable stories and greater.

**Table 3. Base Case Characteristics of the Prototypes**

| Characteristic                     | 3-Story Loaded Corridor   | 5-story Mixed Use   |
|------------------------------------|---|---|
| Space Heating/Cooling <sup>1</sup> | Individual split systems with ducts in conditioned space<br>CZ 1-15: Heat pump<br>CZ 16: Natural gas furnace with air conditioner   | Individual split systems with ducts in conditioned space<br>CZ2-15: Heat pump<br>CZ1, 16: Dual-fuel heat pump with natural gas backup   |
| Ventilation                        | Individual balanced fans, continuously operating  | Individual balanced fans, continuously operating  |
| Water Heater <sup>1</sup>          | Natural gas central boiler with solar thermal sized to meet the prescriptive requirements by climate zone.  | Natural gas central boiler with solar thermal sized to meet the prescriptive requirements by climate zone.  |
| Hot Water Distribution             | Central recirculation   | Central recirculation   |
| Cooking                            | Electric  | Electric  |
| Clothes Drying                     | Electric (central)  | Electric (in-unit)  |
| PV System                          | Sized according to the prescriptive requirements in Equation 170.2-C of the 2022 Title 24 Standards. Size differs by climate zone ranging from 1.60 kW to 2.90 kW per dwelling unit, see Table 4. | Sized according to the prescriptive requirements in Equation 170.2-D of the 2022 Title 24 Standards. Size differs by climate zone ranging from 2.26 kW to 3.34 kW per dwelling unit, see Table 4. |
| Battery System                     | None  | None  |

<sup>1</sup> Equipment efficiencies are equal to minimum federal appliance efficiency standards.

Table 4 summarizes the PV capacities for the base case packages.

**Table 4. Base Package PV Capacities (kW-DC)**

| Climate Zone | Base Package |         |
|--------------|--------------|---------|
|              | 3-Story      | 5-Story |
| CZ01         | 2.00         | 2.26    |
| CZ02         | 1.79         | 2.68    |
| CZ03         | 1.70         | 2.26    |
| CZ04         | 1.75         | 2.68    |
| CZ05         | 1.60         | 2.26    |
| CZ06         | 1.77         | 2.68    |
| CZ07         | 1.67         | 2.68    |
| CZ08         | 1.91         | 2.68    |
| CZ09         | 1.92         | 2.68    |
| CZ10         | 1.98         | 2.68    |
| CZ11         | 2.21         | 2.68    |
| CZ12         | 1.96         | 2.68    |
| CZ13         | 2.33         | 2.68    |
| CZ14         | 1.94         | 2.68    |
| CZ15         | 2.90         | 3.34    |
| CZ16         | 1.76         | 2.26    |

## 3.2 Measure Definitions and Costs

Measures evaluated in this study fall into two categories: those associated with general efficiency, onsite generation, and demand flexibility and those associated with building electrification. The Reach Codes Team selected measures based on cost-effectiveness as well as decades of experience with residential architects, builders, and engineers along with general knowledge of the relative consumer acceptance of many measures. This analysis focused on measures that impacted the residential dwelling units only.

The following sections describe the details and incremental cost assumptions for each of the measures. Incremental costs represent the equipment, installation, replacement, and maintenance costs of the proposed measures relative to the base case. Replacement costs are applied for roofs, mechanical equipment, PV inverters and battery systems over the 30-year evaluation period. Incremental maintenance costs are estimated for PV systems, but not any other measures. Costs were estimated to reflect costs to the building owner. All costs are provided as present value in 2023 (2023 PV\$).

The Reach Codes Team obtained measure costs from distributors, contractors, literature review, and online sources such as Home Depot and RS Means. Contractor markups are incorporated. These are the Reach Codes Team best estimate of average costs statewide. Regional variation in costs is not accounted for, although it's recognized that local costs may differ. Cost increases due to recent high inflation rates and supply chain delays are not included.

### 3.2.1 Efficiency, Solar PV, and Batteries

The following are descriptions of each of the efficiency, PV, and battery measures evaluated under this analysis and applied in at least one of the packages presented in this report. Table 5 summarizes the incremental cost assumptions for each of these measures. These measures were evaluated for all climate zones but were ultimately adopted in a subset of climate zones based on cost-effectiveness outcomes.

**Lower U-Factor Fenestration:** Reduce window U-factor to 0.24. The prescriptive U-factor is 0.30 in all climate zones except Climate Zones 7 and 8 where it is 0.34. This measure is included in Climate Zone 16 only.

**Cool Roof:** Install a roofing product that's rated by the Cool Roof Rating Council to have an aged solar reflectance (ASR) equal to or greater than 0.70. Low-sloped roofs were assumed in all cases. The 2022 Title 24 specifies a prescriptive ASR of 0.63 for Climate Zones 9 through 11 and 13 through 15. This measure is included in Climate Zones 9 through 15.

**Low Pressure Drop Ducts:** Upgrade the duct distribution system to reduce external static pressure and meet a maximum fan efficacy of 0.35 Watts per cfm. This may involve upsizing ductwork, reducing the total effective length of ducts, and/or selecting low pressure drop components such as filters. Fan watt draw must be verified by a HERS rater according to the procedures outlined in the 2022 Reference Appendices RA3.3 (California Energy Commission, 2022b). This measure is included in Climate Zones 1 and 10 through 16.

**Verified Low Leakage Ducts in Conditioned Space:** Seal the ducts to achieve a measured leakage no greater than 25 cfm leakage to outside. This may be verified using a guarded blower door test to isolate leakage to outside. Alternatively, this can also be satisfied by demonstrating that total leakage is not greater than 25 cfm. Ducts are assumed to already be located in conditioned space in the baseline. This measure is included in all climate zones.

**Solar PV:** Installation of on-site PV is required in the 2022 residential code unless an exception is met. The PV sizing methodology in each package was developed to offset annual building electricity use and avoid oversizing which would violate net energy metering (NEM) rules.<sup>6</sup> In all cases, PV is evaluated in CBECC according to the California Flexible Installation (CFI) assumptions. This measure is included in all climate zones.

**Battery Energy Storage:** A battery system was evaluated in CBECC-Res with control type set to "Time-of-Use" and with default efficiencies of 95% for both charging and discharging. This control option assumes the battery system will

<sup>6</sup> NEM rules apply to the IOU territories only.

charge or discharge based on a utility tariff time-of use signal. To qualify, the battery system must meet the requirements outlined in the 2022 Reference Appendices JA12.2.3.2 (California Energy Commission, 2022b). This measure is included in all climate zones but only for the 3-story prototype. A 100kWh battery was applied following the battery sizing requirements for multifamily buildings more than three habitable stories per Equation 170.2-E of the 2022 Energy Code.

Table 5. Incremental Cost Assumptions

| Measure   | Performance Level          | Incremental Cost per Dwelling Unit (2023 PV\$) |          | Source & Notes   |
|---|----------------------------|--|----------|--|
|   |                            | 3-Story  | 5-Story  |  |
| Non-Preempted Measures                          |                            |  |          |  |
| Window U-factor                                 | 0.24 vs 0.30               | \$536  | \$489    | \$4.23/ft² of window area based on analysis conducted for the 2019 and 2022 Title 24 cycles (Statewide CASE Team, 2018).   |
| Low-Sloped Cool Roof Aged Solar Reflectance     | 0.63 vs 0.10               | \$314  | \$222    | \$0.525/ft² of roof area first incremental cost based on the 2022 Residential Additions and Alterations CASE Report (Statewide CASE Team, 2020b).Total costs assume present value of replacement at year 15.   |
|   | 0.70 vs 0.63               | \$24   | \$17     | \$0.04/ft² of roof area first incremental cost based on the 2022 Nonresidential High Performance Envelope CASE Report (Statewide CASE Team, 2020a). Costs assume a blended average across roofing product types. Total costs assume present value of replacement at year 15.   |
| Low Pressure Drop Ducts                         | 0.35 vs 0.45 W/cfm         | \$44   | \$44     | Costs assume half-hour labor per multifamily dwelling unit. Labor rate of \$88 per hour is from 2022 RS Means for sheet metal workers and includes a weighted average City Cost Index for labor for California.  |
| Verified Low Leakage Ducts in Conditioned Space | ≤25 cfm leakage to outside | \$132  | \$132    | Costs assume half-hour labor per multifamily dwelling unit and a \$100 HERS Rater fee. Labor rate of \$88 per hour is from 2022 RS Means for sheet metal workers and includes a weighted average City Cost Index for labor for California. Ducts are already assumed to be located in conditioned space and the incremental costs reflect additional sealing and testing only.   |
| PV + Battery                                    |                            |  |          |  |
| PV System                                       | First Cost                 | \$1.47/W                                       | \$1.47/W | First costs from LBNL’s Tracking the Sun 2022 costs (Barbose, Darghouth, O’Shaughnessy, & Forrester, 2022) and represent median costs in California in 2021 of \$2.10/WDC for nonresidential greater than 100kWDC systems. The first cost was reduced by the solar energy Investment Tax Credit (ITC) of 30%. <sup>1</sup> Costs are presented as the average of 2023, 2024, and 2025.<br>Inverter replacement cost of \$0.14/WDC present value includes replacements at year 11 at \$0.15/WDC (nominal) and at year 21 at \$0.12/WDC (nominal) per the 2019 PV CASE Report (California Energy Commission, 2017).<br>System maintenance costs of \$0.31/WDC present value assume \$0.02/WDC (nominal) annually per the 2019 PV CASE Report (California Energy Commission, 2017). |
|   | Inverter replacement       | \$0.14/W                                       | \$0.14/W |  |
|   | Maintenance                | \$0.31/W                                       | \$0.31/W |  |

| Measure | Performance Level | Incremental Cost per Dwelling Unit (2023 PV\$) |         | Source & Notes   |
|---------|-------------------|--|---------|--|
|         |                   | 3-Story  | 5-Story |  |
| Battery | First cost        | \$700/kWh                                      | n/a     | First cost of \$1,000/kWh from LBNL's Tracking the Sun 2022 costs (Barbose, Darghouth, O'Shaughnessy, & Forrester, 2022) for residential systems > 30kWh. The report derived costs from California's Self-Generation Incentive Program (SGIP) residential participant cost data. First cost is reduced by the solar energy ITC of 30%. <sup>1</sup> No SGIP incentives are included. Costs are assumed to remain consistent at \$1,000/kWh through 2025 and then reduced by 7% annually based on SDG&E's Behind-the-Meter Battery Market Study (E-Source companies, 2020) over a 10 year period. Replacement is assumed at years 10 and 20. At year 10 the replacement cost is based on the average of expected 2033, 2034, and 2035 costs after applying the ITC for a future value cost of \$435. Replacement cost at year 20 is based on a future value cost of \$484 and does not include any ITC reduction. |
|         | Replacement cost  | \$564/kWh                                      | n/a     |  |

<sup>1</sup>As part of the Inflation Reduction Act in August 2022 the Section 25D Investment Tax Credit was extended and raised to 30% through 2032 with a step-down to 26% in 2033 and 22% in 2034. It's assumed that the ITC is not renewed and is 0% starting in 2035. <https://www.irs.gov/pub/taxpros/fs-2022-40.pdf>.

## 3.2.2 All-Electric

This analysis compared a code compliant mixed fuel prototype, which uses natural gas for water heating only in most climate zones, with a code compliant all-electric prototype. In these cases, the relative costs between natural gas and electric appliances and natural gas infrastructure and the associated infrastructure costs for not providing natural gas to the building were included.

To estimate costs the Reach Codes Team leveraged costs from the 2022 Multifamily All-Electric CASE Report (Statewide CASE Team, 2020c) and the 2019 reach code multifamily cost-effectiveness studies (Statewide Reach Codes Team, 2020), (Statewide Reach Codes Team, 2021)), and online equipment research. Present value replacement costs are included in the total lifetime incremental costs.

### 3.2.2.1 Water Heating

Federal regulations establish minimum efficiency requirements for heat pump water heaters with rated storage volume less than 120 gallons. While some heat pump water heaters falling into this regulated category can be used in a central water heater design, they are not required and therefore this measure does not trigger federal preemption and heat pump equipment of any efficiency level may be used for this analysis to justify the basis of a reach code.

For the central heat pump water heating system in the 3-story prototype the system design was based on the 2022 All-Electric Multifamily CASE Report (Statewide CASE Team, 2020c) and used CO<sub>2</sub> refrigerant based heat pump water heaters (four Sanden GS3-45HPA-US units), 525 gallons of storage, and a 250 gallon electric resistance swing tank. The 2022 CASE work based the 5-story system design on Colmac R-134a refrigerant heat pump water heaters. While this is an acceptable design, R-134a or R-410a refrigerant heat pump water heaters were found to be less cost-effective for the prototypes evaluated in this analysis due to higher incremental costs and lower overall performance relative to CO<sub>2</sub> refrigerant products. As such, the Reach Codes Team evaluated a CO<sub>2</sub> refrigerant system for the 5-story prototype for this analysis. As part of the 2025 Energy Code update cycle, designs for both multifamily prototypes are being reexamined using CO<sub>2</sub> refrigerant heat pump water heaters. While full design and cost information was not yet available for this analysis, preliminary design data was used to inform sizing of a Sanden system for this prototype. The system used 10 heat pump water heaters (Sanden GS3-45HPA-US units), 800 gallons of storage, and a 200 gallon electric resistance swing tank.

Table 6 reports costs for the central heat pump water heating systems relative to a gas boiler system with solar thermal that meets the prescriptive requirements of 20% solar fraction in Climate Zones 1 through 9 and 35% solar fraction in Climate Zones 10 through 16. Costs include equipment and labor, gas piping within the building for the boiler system, and additional electrical service necessary for the heat pump system. Replacement costs are based on an effective useful life of 15 years for the water heaters and tanks, and 20 years for the solar thermal collectors. For the solar thermal systems, it's also assumed that the glycol is replaced at years 9, 18 and 27. Additional details on cost assumptions are presented in Appendix 7.3 Cost Details.

**Table 6. Heat Pump Water Heater Incremental System Costs (Present Value (2023\$))**

| Item                               |           | 3-Story            |                   | 5-Story            |                   | Source & Notes  |  |
|------------------------------------|-----------|--------------------|-------------------|--------------------|-------------------|---|--|
|                                    |           | Central Gas Boiler | Central Heat Pump | Central Gas Boiler | Central Heat Pump |   |  |
| First Cost                         | CZs 1-9   | \$173,772          | \$211,531         | \$279,163          | \$343,920         | 3-story costs directly from 2022 Multifamily All-Electric CASE Report. 5-story costs estimated based on component costs for the 3-story from the CASE report. |  |
|                                    | CZs 10-16 | \$182,810          |                   | \$300,883          |                   |   |  |
| Replacement Cost                   | CZs 1-9   | \$32,297           | \$44,263          | \$59,930           | \$110,659         |   |  |
|                                    | CZs 10-16 | \$36,943           |                   | \$69,361           |                   |   |  |
| Total Incremental Cost             | CZs 1-9   | n/a                | \$49,725          | n/a                | \$115,486         |   |  |
|                                    | CZs 10-16 |                    | \$36,041          |                    | \$84,335          |   |  |
| Incremental Cost per Dwelling Unit | CZs 1-9   |                    | \$1,381           |                    | \$1,312           |   |  |
|                                    | CZs 10-16 |                    | \$1,001           |                    | \$958             |   |  |

### 3.2.2.2 Space Heating

Table 7 presents the costs for heat pump space heater conversion from gas equipment. In most climate zones the baseline per the 2022 Energy Code is a heat pump space heater, so these costs are only applied in a couple of instances. For the 3-story prototype the baseline in Climate Zone 16 is a gas furnace and air conditioner. For the 5-story prototype the baseline in Climate Zones 1 and 16 is a dual fuel heat pump with a gas furnace as backup. Costs include equipment and labor, gas piping within the building for the boiler system, and additional electrical service necessary for the heat pump system. Most of the cost difference between the two systems is attributed to higher labor costs to install the gas system as a result of gas piping and venting. Additional details on cost assumptions are presented in Appendix 7.3 Cost Details.

**Table 7. Heat Pump Space Heater Costs per Dwelling Unit (Present Value (2023\$))**

| Item                    | 3-Story            |                  | 5-Story            |                  | Source & Notes  |
|-------------------------|--------------------|------------------|--------------------|------------------|---|
|                         | Furnace + Split AC | Heat Pump        | Furnace + Split HP | Heat Pump        |   |
| First Cost              | \$20,667           | \$16,776         | \$21,245           | \$16,597         | Costs largely based on the 2022 Multifamily All-Electric CASE Report with some updates to reflect online equipment cost research and labor cost alignments. |
| Replacement Cost        | \$8,059            | \$7,326          | \$9,052            | \$7,326          | See lifetimes referenced in Table 8.  |
| Residual Value          | (\$1,591)          | \$0              | \$0                | \$0              | Residual value at the end of the 30-year analysis period was accounted for to represent the remaining life of any equipment.                                |
| <b>Total</b>            | <b>\$27,135</b>    | <b>\$24,102</b>  | <b>\$30,296</b>    | <b>\$23,924</b>  |   |
| <b>Incremental Cost</b> |                    | <b>(\$3,032)</b> |                    | <b>(\$6,373)</b> |   |

Equipment lifetimes applied in this analysis for the space conditioning measures are summarized in Table 8. The lifetime for the heat pump, furnace, and air conditioner are based on the Database for Energy Efficient Resources (DEER) (California Public Utilities Commission, 2021b). In DEER, heat pump and air conditioner measures are assigned an effective useful lifetime (EUL) of 15 years and a furnace an EUL of 20 years. The heating and cooling system components are typically replaced at the same time when one reaches the end of its life and the other is near

it. Therefore, it is assumed that both the furnace and air conditioner are replaced at the same time at year 17.5, halfway between 15 and 20 years. For HVAC system costing, air-conditioning is included in all cases in both the base case and proposed models.

**Table 8. Lifetime of Water Heating & Space Conditioning Equipment Measures**

| Measure             | Lifetime |
|---------------------|----------|
| Gas Furnace         | 17.5     |
| Air Conditioner     | 17.5     |
| Heat Pump           | 15       |
| Dual Fuel Heat Pump | 15       |

### 3.2.2.3 Natural Gas Infrastructure

Eliminating natural gas to a building saves costs associated with connecting a service line from the street main to the building, piping distribution within the building, and monthly meter customer charges from the utility. This section focuses on the first item, not connecting gas service to the building. The latter two are captured in the appliance costs and the utility bill analysis. Cost savings for removing natural gas infrastructure to a multifamily building in IOU territory are presented in Table 9 and Table 10. These costs are applied as cost savings for the all-electric case when compared to the mixed fuel baseline.

These costs are project dependent and may be significantly impacted by such factors as utility territory, site characteristics, distance to the nearest natural gas main and main location, joint trenching, whether work is conducted by the utility or a private contractor, and number of dwelling units per development. All gas utilities participating in this study were solicited for cost information.

**Service Extension:** Service extension costs to the building were taken from a PG&E memo dated December 5, 2019 to Energy Commission staff (see Appendix 7.4 PG&E Gas Infrastructure Cost Memo for a copy of the memo). The estimated cost of \$6,750 excludes costs for trenching and assumes nonresidential new construction within a developed area. For the 5-story building the cost is apportioned between the residential and nonresidential spaces in the building based on associated conditioned floor areas where 84 percent is residential. All of the spaces in the 3-story building are residential based.

Today, total costs are reduced to account for deductions per the Utility Gas Main Extensions rules.<sup>7</sup> These rules categorize distribution line extensions as “refundable” costs, which are offset or subsidized by all other ratepayers. The CPUC issued a Decision in September 2022 that eliminates the subsidies effective July 1, 2023 (California Public Utilities Commission, 2022). Since most of the development that will occur during the three-year 2022 code cycle (2023-2025) will not be subject to these deduction allowances they are not included in this analysis.

**Meter:** Cost per meter provided by PG&E of \$3,600 for a commercial meter to serve the central water heating and \$600 per multifamily dwelling unit. The \$600 dwelling unit meter is only applied in Climate Zone 16 for the 3-story prototype and Climate Zones 1 and 16 for the 5-story prototypes where gas is used either for primary or backup space heating. Two scenarios are presented in the tables. One is the case with electric space heating, no in-unit gas and the only residential gas use is to serve the central water heating system. The other case represents the scenario where there is in-unit gas to service space heating.

<sup>7</sup> PG&E Rule 15: [https://www.pge.com/tariffs/assets/pdf/tariffbook/GAS\\_RULES\\_15.pdf](https://www.pge.com/tariffs/assets/pdf/tariffbook/GAS_RULES_15.pdf).  
 SoCalGas Rule 20: <https://www.socalgas.com/regulatory/tariffs/tm2/pdf/20.pdf>.  
 SDG&E Rule 15: [https://tariff.sdge.com/tm2/pdf/GAS\\_GAS-RULES\\_GRULE15.pdf](https://tariff.sdge.com/tm2/pdf/GAS_GAS-RULES_GRULE15.pdf).

**Natural Gas Plan Review:** Total costs are based on TRC's 2019 reach code analysis for Palo Alto (TRC, 2018 ). The cost for the 5-story prototype is apportioned between the residential and nonresidential spaces in the building in the same way as was done for the service extension costs.

**Table 9. IOU Natural Gas Infrastructure Cost Savings for All-Electric Building**

| Item              |                               | 3-Story  | 5-Story  |
|-------------------|-------------------------------|----------|----------|
| Service Extension |                               | \$6,750  | \$5,695  |
| Meter             | No In-Unit Gas (Gas DHW only) | \$3,600  | \$3,600  |
|                   | In-Unit Gas                   | \$25,200 | \$56,400 |
| Plan Review       |                               | \$2,316  | \$1,954  |

**Table 10. Multifamily IOU Total Natural Gas Infrastructure Costs**

| Prototype | Scenario       | Total Building | Per Dwelling Unit |
|-----------|----------------|----------------|-------------------|
| 3-Story   | No In-Unit Gas | \$12,666       | \$352             |
|           | In-Unit Gas    | \$34,266       | \$952             |
| 5-Story   | No In-Unit Gas | \$11,248       | \$128             |
|           | In-Unit Gas    | \$64,048       | \$728             |

CPAU provides gas service to its customers and therefore separate costs were evaluated based on CPAU gas service connection fees.<sup>8</sup> Table 11 presents the breakdown of gas infrastructure costs used in this analysis for CPAU. The same approach to apportioning the total building costs to the residential spaces as described in the IOU section was applied here for the service extension and plan review costs for the 5-story prototype. Meter costs were based on \$1,772 for an 800 cubic foot per hour commercial meter for the central water heating system.

**Table 11. Multifamily CPAU Total Natural Gas Infrastructure Costs**

| Item              | 3-Story | 5-Story |
|-------------------|---------|---------|
| Service Extension | \$5,892 | \$4,971 |
| Meter             | \$1,772 | \$1,772 |
| Plan Review       | \$2,557 | \$2,157 |

### 3.3 Measure Packages

The Reach Codes Team evaluated three packages for mixed fuel homes and five packages for all-electric homes for each prototype and climate zone, as described below.

1. All-Electric Prescriptive Code: This package meets all the prescriptive requirements of the 2022 Energy Code.
2. All-Electric Prescriptive Code + PV: Using the code minimum package as a starting point, PV capacity was added to offset 100 percent of the estimated annual electricity use.
3. Mixed Fuel Efficiency Only: This package uses only efficiency measures that do not trigger federal preemption including envelope and duct distribution efficiency measures.

<sup>8</sup> CPAU Schedule G-5 effective 09-01-2019: <https://www.cityofpaloalto.org/files/assets/public/utilities/utilities-engineering/general-specifications/gas-service-connection-fees.pdf>

4. **Mixed Fuel Efficiency + PV + Battery:** Using the Efficiency Package as a starting point, PV capacity was added to offset 100 percent of the estimated annual electricity use. A battery system was also added. This package only applies to the 3-story prototype. The 5-story prototype includes a battery system in the baseline per the 2022 prescriptive requirements.
5. **Mixed Fuel Efficiency + PV:** Using the Efficiency Package as a starting point, PV capacity was added to offset 100 percent of the estimated annual electricity use. This package only applies to the 5-story prototype.

## 4 Results

Cost-effectiveness results are presented per prototype and measure packages described in Section 3.3. The TDV and On-Bill based cost-effectiveness results are presented in terms of B/C ratio and NPV. Energy savings, compliance margin, utility bill savings, and incremental costs are also shown.

In the following figures, **green** highlighting indicates that the case is cost-effective with a B/C ratio greater than or equal to 1 and a NPV greater than or equal to 0. **Red** highlighting indicates the case is not cost-effective.

Compliance margins are presented as percentages both for the efficiency TDV and the source energy metrics. A compliance margin that is equal to or greater than 0 indicates the case is code compliant.

### 4.1 All-Electric Prescriptive Code

Table 12 and Table 13 shows results for the multifamily all-electric prescriptive code case compared to the 2022 baseline. For both prototypes this scenario is cost-effective based on TDV in all climate zones. This scenario is only On-Bill cost-effective in a few climate zones. The 3-story all-electric case is cost-effective On-Bill in Climate Zones 1 through 3, 4 in CPAU territory, 12 in SMUD territory, and 16. The 5-story all-electric case is cost-effective On-Bill in Climate Zones 1, 4, 12 in SMUD territory, and 16.

In most cases there is a small net increase in utility cost in the first year.

There is an incremental cost for the central heat pump water heater ranging from \$361 to \$697 per dwelling unit.

The all-electric packages applied to the 3-story prototype in Climate Zone 16 and the 5-story prototype in Climate Zones 1 and 16 incorporate both gas to electric water heating and gas to electric space heating measures. In these cases, there are significant cost savings due to the avoided first costs of installing a gas furnace as compared to a heat pump. As a result, these cases are On-Bill cost-effective.

These results reflect a CO<sub>2</sub> refrigerant based central heat pump water heating system. The 5-story prototype was also evaluated with a R-134a refrigerant based central heat pump water heater and these results are shown in Appendix 7.5 Central Heat Pump Water Heater Comparison.

Table 12. 3-Story Cost-Effectiveness Results per Dwelling Unit: All-Electric Prescriptive Code

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |           | TDV       |         |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|-----------|-----------|---------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV       | B/C Ratio | NPV     |
| CZ01         | PGE                   | 26%                        | 15%                | -904                      | 135                         | (\$19)               | \$1,676            | \$97             | \$429              | 3.9       | \$1,247   | >1        | \$4,158 |
| CZ02         | PGE                   | 20%                        | 11%                | -801                      | 115                         | (\$30)               | \$1,061            | \$697            | \$1,029            | 1.0       | \$32      | 9.9       | \$2,998 |
| CZ03         | PGE                   | 21%                        | 10%                | -789                      | 115                         | (\$26)               | \$1,148            | \$697            | \$1,029            | 1.1       | \$119     | 9.9       | \$2,990 |
| CZ04         | PGE                   | 18%                        | 9%                 | -759                      | 109                         | (\$31)               | \$922              | \$697            | \$1,029            | 0.9       | (\$108)   | 9.2       | \$2,767 |
| CZ04         | CPAU                  | 18%                        | 9%                 | -759                      | 109                         | \$233                | \$8,191            | \$765            | \$1,097            | 7.5       | \$7,094   | 7.7       | \$2,700 |
| CZ05         | PGE                   | 23%                        | 9%                 | -789                      | 112                         | (\$30)               | \$1,009            | \$697            | \$1,029            | 0.98      | (\$21)    | 9.3       | \$2,782 |
| CZ05         | PGE/SCG               | 23%                        | 9%                 | -789                      | 112                         | (\$79)               | (\$515)            | \$697            | \$1,029            | 0.0       | (\$1,545) | 9.3       | \$2,782 |
| CZ06         | SCE/SCG               | 18%                        | 7%                 | -709                      | 100                         | (\$61)               | (\$226)            | \$697            | \$1,029            | 0.0       | (\$1,255) | 8.6       | \$2,551 |
| CZ07         | SDGE                  | 20%                        | 8%                 | -704                      | 102                         | (\$69)               | (\$427)            | \$697            | \$1,029            | 0.0       | (\$1,456) | 9.1       | \$2,712 |
| CZ08         | SCE/SCG               | 13%                        | 6%                 | -689                      | 96                          | (\$61)               | (\$302)            | \$697            | \$1,029            | 0.0       | (\$1,331) | 8.2       | \$2,432 |
| CZ09         | SCE                   | 13%                        | 5%                 | -698                      | 96                          | (\$64)               | (\$351)            | \$697            | \$1,029            | 0.0       | (\$1,380) | 8.0       | \$2,363 |
| CZ10         | SCE/SCG               | 14%                        | 7%                 | -701                      | 83                          | (\$88)               | (\$1,109)          | \$446            | \$649              | 0.0       | (\$1,758) | >1        | \$1,959 |
| CZ10         | SDGE                  | 14%                        | 7%                 | -701                      | 83                          | (\$112)              | (\$1,803)          | \$446            | \$649              | 0.0       | (\$2,452) | >1        | \$1,959 |
| CZ11         | PGE                   | 14%                        | 10%                | -740                      | 91                          | (\$64)               | (\$177)            | \$446            | \$649              | 0.0       | (\$826)   | >1        | \$2,212 |
| CZ12         | PGE                   | 17%                        | 11%                | -755                      | 94                          | (\$62)               | (\$70)             | \$446            | \$649              | 0.0       | (\$719)   | >1        | \$2,297 |
| CZ12         | SMUD/PGE              | 17%                        | 11%                | -755                      | 94                          | \$68                 | \$2,942            | \$446            | \$649              | 4.5       | \$2,293   | >1        | \$2,297 |
| CZ13         | PGE                   | 13%                        | 9%                 | -717                      | 86                          | (\$65)               | (\$291)            | \$446            | \$649              | 0.0       | (\$940)   | >1        | \$2,050 |
| CZ14         | SCE/SCG               | 13%                        | 7%                 | -748                      | 83                          | (\$102)              | (\$1,413)          | \$446            | \$649              | 0.0       | (\$2,063) | >1        | \$1,759 |
| CZ14         | SDGE                  | 13%                        | 7%                 | -748                      | 83                          | (\$128)              | (\$2,191)          | \$446            | \$649              | 0.0       | (\$2,841) | >1        | \$1,759 |
| CZ15         | SCE/SCG               | 5%                         | 2%                 | -607                      | 64                          | (\$89)               | (\$1,403)          | \$446            | \$649              | 0.0       | (\$2,053) | >1        | \$1,305 |
| CZ16         | PG&E                  | 24%                        | 29%                | -1,928                    | 185                         | (\$178)              | (\$1,066)          | (\$4,045)        | (\$2,983)          | 2.8       | \$1,917   | >1        | \$4,352 |

Table 13. 5-Story Cost-Effectiveness Results per Dwelling Unit: All-Electric Prescriptive Code

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |           | TDV       |         |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|-----------|-----------|---------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV       | B/C Ratio | NPV     |
| CZ01         | PGE                   | 14%                        | 9%                 | -1,146                    | 147                         | (\$49)               | \$1,209            | (\$4,639)        | (\$5,788)          | >1        | \$6,998   | >1        | \$9,816 |
| CZ02         | PGE                   | 9%                         | 6%                 | -888                      | 120                         | (\$45)               | \$809              | \$608            | \$1,185            | 0.7       | (\$375)   | 3.0       | \$2,270 |
| CZ03         | PGE                   | 11%                        | 7%                 | -874                      | 120                         | (\$46)               | \$778              | \$608            | \$1,185            | 0.7       | (\$407)   | 3.1       | \$2,421 |
| CZ04         | PGE                   | 9%                         | 6%                 | -824                      | 113                         | \$18                 | \$2,130            | \$608            | \$1,185            | 1.8       | \$945     | 3.1       | \$2,393 |
| CZ04         | CPAU                  | 9%                         | 6%                 | -824                      | 113                         | \$230                | \$8,205            | \$635            | \$1,211            | 6.8       | \$6,994   | 3.0       | \$2,367 |
| CZ05         | PGE                   | 12%                        | 6%                 | -871                      | 117                         | (\$47)               | \$706              | \$608            | \$1,185            | 0.6       | (\$479)   | 2.8       | \$2,065 |
| CZ05         | PGE/SCG               | 12%                        | 6%                 | -871                      | 117                         | (\$99)               | (\$919)            | \$608            | \$1,185            | 0.0       | (\$2,103) | 2.8       | \$2,065 |
| CZ06         | SCE/SCG               | 9%                         | 5%                 | -739                      | 104                         | (\$10)               | \$986              | \$608            | \$1,185            | 0.8       | (\$199)   | 2.9       | \$2,183 |
| CZ07         | SDGE                  | 11%                        | 6%                 | -735                      | 106                         | (\$74)               | (\$500)            | \$608            | \$1,185            | 0.0       | (\$1,685) | 2.9       | \$2,215 |
| CZ08         | SCE/SCG               | 8%                         | 4%                 | -710                      | 100                         | (\$79)               | (\$644)            | \$608            | \$1,185            | 0.0       | (\$1,829) | 3.0       | \$2,259 |
| CZ09         | SCE                   | 7%                         | 4%                 | -725                      | 100                         | (\$53)               | (\$51)             | \$608            | \$1,185            | 0.0       | (\$1,236) | 3.0       | \$2,274 |
| CZ10         | SCE/SCG               | 7%                         | 4%                 | -729                      | 84                          | (\$111)              | (\$1,615)          | \$361            | \$831              | 0.0       | (\$2,445) | 2.7       | \$1,374 |
| CZ10         | SDGE                  | 7%                         | 4%                 | -729                      | 84                          | (\$137)              | (\$2,404)          | \$361            | \$831              | 0.0       | (\$3,234) | 2.7       | \$1,374 |
| CZ11         | PGE                   | 8%                         | 5%                 | -790                      | 92                          | (\$86)               | (\$663)            | \$361            | \$831              | 0.0       | (\$1,494) | 3.1       | \$1,656 |
| CZ12         | PGE                   | 9%                         | 6%                 | -809                      | 96                          | (\$83)               | (\$527)            | \$361            | \$831              | 0.0       | (\$1,358) | 3.0       | \$1,620 |
| CZ12         | SMUD/PGE              | 9%                         | 6%                 | -809                      | 96                          | \$62                 | \$2,831            | \$361            | \$831              | 3.4       | \$2,000   | 3.0       | \$1,620 |
| CZ13         | PGE                   | 7%                         | 5%                 | -754                      | 88                          | (\$83)               | (\$686)            | \$361            | \$831              | 0.0       | (\$1,517) | 3.0       | \$1,570 |
| CZ14         | SCE/SCG               | 6%                         | 3%                 | -803                      | 84                          | (\$131)              | (\$2,085)          | \$361            | \$831              | 0.0       | (\$2,916) | 2.2       | \$928   |
| CZ14         | SDGE                  | 6%                         | 3%                 | -803                      | 84                          | (\$165)              | (\$3,106)          | \$361            | \$831              | 0.0       | (\$3,937) | 2.2       | \$928   |
| CZ15         | SCE/SCG               | 3%                         | 1%                 | -602                      | 65                          | (\$105)              | (\$1,775)          | \$361            | \$831              | 0.0       | (\$2,606) | 1.9       | \$695   |
| CZ16         | PG&E                  | 9%                         | 11%                | -1,388                    | 142                         | (\$127)              | (\$675)            | (\$4,886)        | (\$6,142)          | 9.1       | \$5,467   | >1        | \$6,704 |

4.2 All-Electric Plus PV

Table 14 and Table 15 present cost-effectiveness results for the all-electric plus PV packages for the 3-story and 5-story prototypes, respectively. All cases are cost-effective both On-Bill and based on TDV.

Table 14. 3-Story Cost-Effectiveness Results per Dwelling Unit: All-Electric 100% PV

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |          | TDV       |          |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|----------|-----------|----------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV      | B/C Ratio | NPV      |
| CZ01         | PGE                   | 26%                        | 24%                | 2,127                     | 135                         | \$782                | \$20,242           | \$3,638          | \$5,034            | 4.0       | \$15,208 | 3.2       | \$9,448  |
| CZ02         | PGE                   | 20%                        | 20%                | 1,835                     | 115                         | \$653                | \$16,910           | \$3,294          | \$4,406            | 3.8       | \$12,504 | 3.3       | \$8,632  |
| CZ03         | PGE                   | 21%                        | 20%                | 1,711                     | 115                         | \$614                | \$15,998           | \$3,076          | \$4,123            | 3.9       | \$11,875 | 3.4       | \$8,209  |
| CZ04         | PGE                   | 18%                        | 18%                | 1,558                     | 109                         | \$559                | \$14,587           | \$2,841          | \$3,818            | 3.8       | \$10,770 | 3.6       | \$8,230  |
| CZ04         | CPAU                  | 18%                        | 18%                | 1,558                     | 109                         | \$489                | \$14,138           | \$2,909          | \$3,886            | 3.6       | \$10,253 | 3.6       | \$8,162  |
| CZ05         | PGE                   | 23%                        | 20%                | 1,604                     | 112                         | \$579                | \$15,137           | \$2,826          | \$3,798            | 4.0       | \$11,338 | 3.6       | \$8,026  |
| CZ05         | PGE/SCG               | 23%                        | 20%                | 1,604                     | 112                         | \$531                | \$13,613           | \$2,826          | \$3,798            | 3.6       | \$9,814  | 3.6       | \$8,026  |
| CZ06         | SCE/SCG               | 18%                        | 17%                | 1,207                     | 100                         | \$378                | \$9,795            | \$2,364          | \$3,197            | 3.1       | \$6,598  | 3.8       | \$7,092  |
| CZ07         | SDGE                  | 20%                        | 21%                | 1,528                     | 102                         | \$723                | \$19,318           | \$2,777          | \$3,734            | 5.2       | \$15,584 | 3.5       | \$7,623  |
| CZ08         | SCE/SCG               | 13%                        | 17%                | 1,393                     | 96                          | \$426                | \$10,842           | \$2,569          | \$3,464            | 3.1       | \$7,378  | 3.9       | \$7,908  |
| CZ09         | SCE                   | 13%                        | 15%                | 1,204                     | 96                          | \$379                | \$9,756            | \$2,335          | \$3,160            | 3.1       | \$6,596  | 3.9       | \$7,158  |
| CZ10         | SCE/SCG               | 14%                        | 18%                | 1,381                     | 83                          | \$404                | \$10,130           | \$2,237          | \$2,978            | 3.4       | \$7,152  | 4.1       | \$7,031  |
| CZ10         | SDGE                  | 14%                        | 18%                | 1,381                     | 83                          | \$621                | \$16,493           | \$2,237          | \$2,978            | 5.5       | \$13,514 | 4.1       | \$7,031  |
| CZ11         | PGE                   | 14%                        | 19%                | 1,843                     | 91                          | \$625                | \$15,782           | \$2,940          | \$3,893            | 4.1       | \$11,889 | 3.4       | \$7,748  |
| CZ12         | PGE                   | 17%                        | 19%                | 1,704                     | 94                          | \$579                | \$14,777           | \$2,756          | \$3,654            | 4.0       | \$11,124 | 3.6       | \$7,607  |
| CZ12         | SMUD/PGE              | 17%                        | 19%                | 1,704                     | 94                          | \$399                | \$10,615           | \$2,756          | \$3,654            | 2.9       | \$6,961  | 3.6       | \$7,607  |
| CZ13         | PGE                   | 13%                        | 17%                | 1,572                     | 86                          | \$544                | \$13,822           | \$2,567          | \$3,408            | 4.1       | \$10,415 | 3.6       | \$7,148  |
| CZ14         | SCE/SCG               | 13%                        | 18%                | 1,572                     | 83                          | \$449                | \$11,152           | \$2,300          | \$3,060            | 3.6       | \$8,092  | 4.2       | \$7,668  |
| CZ14         | SDGE                  | 13%                        | 18%                | 1,572                     | 83                          | \$688                | \$18,158           | \$2,300          | \$3,060            | 5.9       | \$15,098 | 4.2       | \$7,668  |
| CZ15         | SCE/SCG               | 5%                         | 11%                | 1,163                     | 64                          | \$330                | \$8,164            | \$1,966          | \$2,626            | 3.1       | \$5,539  | 3.9       | \$5,567  |
| CZ16         | PG&E                  | 24%                        | 38%                | 1,371                     | 185                         | \$700                | \$19,307           | (\$1,064)        | \$894              | 21.6      | \$18,412 | 58.9      | \$11,596 |

Table 15. 5-Story Cost-Effectiveness Results per Dwelling Unit: All-Electric 100% PV

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |          | TDV       |          |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|----------|-----------|----------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV      | B/C Ratio | NPV      |
| CZ01         | PGE                   | 14%                        | 21%                | 1,437                     | 147                         | \$629                | \$16,919           | (\$1,574)        | (\$1,803)          | >1        | \$18,721 | >1        | \$18,222 |
| CZ02         | PGE                   | 9%                         | 14%                | 428                       | 120                         | \$262                | \$7,918            | \$1,930          | \$2,904            | 2.7       | \$5,015  | 4.0       | \$8,679  |
| CZ03         | PGE                   | 11%                        | 16%                | 682                       | 120                         | \$327                | \$9,417            | \$2,121          | \$3,152            | 3.0       | \$6,265  | 4.0       | \$9,285  |
| CZ04         | PGE                   | 9%                         | 13%                | 92                        | 113                         | \$207                | \$6,524            | \$1,476          | \$2,313            | 2.8       | \$4,211  | 4.1       | \$7,054  |
| CZ04         | CPAU                  | 9%                         | 13%                | 92                        | 113                         | \$337                | \$10,667           | \$1,502          | \$2,340            | 4.6       | \$8,327  | 4.0       | \$7,027  |
| CZ05         | PGE                   | 12%                        | 16%                | 451                       | 117                         | \$259                | \$7,806            | \$1,815          | \$2,754            | 2.8       | \$5,052  | 4.0       | \$8,096  |
| CZ05         | PGE/SCG               | 12%                        | 16%                | 451                       | 117                         | \$207                | \$6,182            | \$1,815          | \$2,754            | 2.2       | \$3,427  | 4.0       | \$8,096  |
| CZ06         | SCE/SCG               | 9%                         | 12%                | -163                      | 104                         | \$98                 | \$3,449            | \$1,127          | \$1,859            | 1.9       | \$1,590  | 3.8       | \$5,035  |
| CZ07         | SDGE                  | 11%                        | 15%                | 74                        | 106                         | \$192                | \$6,131            | \$1,387          | \$2,198            | 2.8       | \$3,934  | 3.9       | \$6,204  |
| CZ08         | SCE/SCG               | 8%                         | 14%                | 265                       | 100                         | \$154                | \$4,666            | \$1,516          | \$2,365            | 2.0       | \$2,301  | 4.0       | \$7,053  |
| CZ09         | SCE                   | 7%                         | 12%                | 60                        | 100                         | \$122                | \$3,930            | \$1,307          | \$2,093            | 1.9       | \$1,837  | 3.7       | \$5,636  |
| CZ10         | SCE/SCG               | 7%                         | 13%                | 289                       | 84                          | \$131                | \$3,912            | \$1,266          | \$2,007            | 1.9       | \$1,905  | 3.9       | \$5,749  |
| CZ10         | SDGE                  | 7%                         | 13%                | 289                       | 84                          | \$238                | \$6,951            | \$1,266          | \$2,007            | 3.5       | \$4,945  | 3.9       | \$5,749  |
| CZ11         | PGE                   | 8%                         | 17%                | 1,091                     | 92                          | \$417                | \$10,990           | \$2,226          | \$3,256            | 3.4       | \$7,734  | 4.2       | \$10,472 |
| CZ12         | PGE                   | 9%                         | 16%                | 594                       | 96                          | \$263                | \$7,487            | \$1,712          | \$2,587            | 2.9       | \$4,901  | 4.3       | \$8,544  |
| CZ12         | SMUD/PGE              | 9%                         | 16%                | 594                       | 96                          | \$260                | \$7,419            | \$1,712          | \$2,587            | 2.9       | \$4,889  | 4.3       | \$8,544  |
| CZ13         | PGE                   | 7%                         | 17%                | 1,036                     | 88                          | \$398                | \$10,479           | \$2,064          | \$3,045            | 3.4       | \$7,434  | 4.2       | \$9,715  |
| CZ14         | SCE/SCG               | 6%                         | 11%                | 182                       | 84                          | \$102                | \$3,250            | \$1,170          | \$1,883            | 1.7       | \$1,368  | 4.0       | \$5,515  |
| CZ14         | SDGE                  | 6%                         | 11%                | 182                       | 84                          | \$194                | \$5,858            | \$1,170          | \$1,883            | 3.1       | \$3,975  | 4.0       | \$5,515  |
| CZ15         | SCE/SCG               | 3%                         | 10%                | 387                       | 65                          | \$153                | \$4,119            | \$1,238          | \$1,971            | 2.1       | \$2,148  | 3.6       | \$4,998  |
| CZ16         | PG&E                  | 9%                         | 23%                | 1,007                     | 142                         | \$501                | \$13,864           | (\$2,682)        | (\$3,275)          | >1        | \$17,139 | >1        | \$16,140 |

### 4.3 Mixed Fuel Efficiency

Table 16 and Table 17 show results for the Mixed Fuel Efficiency packages. The packages are cost-effective based on at least one of the two metrics in Climate Zones 1, 2, 4, and 8 through 16 for the 3-story prototype and in Climate Zones 2, 4, 6, and 8 through 15 for the 5-story prototype. In all cases the NPV values, whether negative or positive, are small. The compliance impacts are also small.

A summary of measures included in each package is provided in Appendix 7.6 Summary of Measures by Package.

**Table 16. 3-Story Cost-Effectiveness Results per Dwelling Unit: Mixed Fuel Efficiency**

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |         | TDV       |        |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|---------|-----------|--------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV     | B/C Ratio | NPV    |
| CZ01         | PGE                   | 1%                         | 1%                 | 41                        | 0                           | \$12                 | \$273              | \$176            | \$176              | 1.6       | \$98    | 1.2       | \$38   |
| CZ02         | PGE                   | 1%                         | 0%                 | 24                        | 0                           | \$7                  | \$162              | \$132            | \$132              | 1.2       | \$30    | 1.5       | \$62   |
| CZ03         | PGE                   | 1%                         | 0%                 | 17                        | 0                           | \$5                  | \$111              | \$132            | \$132              | 0.8       | (\$21)  | 0.8       | (\$27) |
| CZ04         | PGE                   | 1%                         | 0%                 | 21                        | 0                           | \$6                  | \$141              | \$132            | \$132              | 1.1       | \$9     | 1.3       | \$46   |
| CZ04         | CPAU                  | 1%                         | 0%                 | 21                        | 0                           | \$3                  | \$74               | \$132            | \$132              | 0.6       | (\$58)  | 1.3       | \$46   |
| CZ05         | PGE                   | 1%                         | 0%                 | 19                        | 0                           | \$5                  | \$123              | \$132            | \$132              | 0.9       | (\$9)   | 0.8       | (\$32) |
| CZ05         | PGE/SCG               | 1%                         | 0%                 | 19                        | 0                           | \$5                  | \$123              | \$132            | \$132              | 0.9       | (\$9)   | 0.8       | (\$32) |
| CZ06         | SCE/SCG               | 1%                         | 0%                 | 9                         | 0                           | \$2                  | \$56               | \$132            | \$132              | 0.4       | (\$75)  | 0.7       | (\$44) |
| CZ07         | SDGE                  | 0%                         | 0%                 | 7                         | 0                           | \$3                  | \$72               | \$132            | \$132              | 0.5       | (\$60)  | 0.4       | (\$81) |
| CZ08         | SCE/SCG               | 1%                         | 0%                 | 20                        | 0                           | \$6                  | \$140              | \$132            | \$132              | 1.1       | \$9     | 1.5       | \$59   |
| CZ09         | SCE                   | 1%                         | 0%                 | 28                        | 0                           | \$8                  | \$192              | \$146            | \$156              | 1.2       | \$36    | 1.6       | \$88   |
| CZ10         | SCE/SCG               | 3%                         | 1%                 | 65                        | 0                           | \$20                 | \$447              | \$190            | \$199              | 2.2       | \$247   | 2.4       | \$277  |
| CZ10         | SDGE                  | 3%                         | 1%                 | 65                        | 0                           | \$27                 | \$683              | \$190            | \$199              | 3.4       | \$484   | 2.4       | \$277  |
| CZ11         | PGE                   | 3%                         | 1%                 | 91                        | 0                           | \$30                 | \$699              | \$190            | \$199              | 3.5       | \$499   | 3.5       | \$489  |
| CZ12         | PGE                   | 2%                         | 0%                 | 98                        | 0                           | \$33                 | \$766              | \$381            | \$514              | 1.5       | \$252   | 1.5       | \$273  |
| CZ12         | SMUD/PGE              | 2%                         | 0%                 | 98                        | 0                           | \$17                 | \$396              | \$381            | \$514              | 0.8       | (\$118) | 1.5       | \$273  |
| CZ13         | PGE                   | 4%                         | 1%                 | 99                        | 0                           | \$33                 | \$765              | \$190            | \$199              | 3.8       | \$566   | 3.9       | \$574  |
| CZ14         | SCE/SCG               | 3%                         | 1%                 | 88                        | 0                           | \$26                 | \$585              | \$190            | \$199              | 2.9       | \$385   | 3.1       | \$427  |
| CZ14         | SDGE                  | 3%                         | 1%                 | 88                        | 0                           | \$36                 | \$886              | \$190            | \$199              | 4.4       | \$686   | 3.1       | \$427  |
| CZ15         | SCE/SCG               | 5%                         | 2%                 | 182                       | 0                           | \$54                 | \$1,226            | \$190            | \$199              | 6.1       | \$1,026 | 5.8       | \$957  |
| CZ16         | PG&E                  | 5%                         | 4%                 | 16                        | 12                          | \$34                 | \$1,012            | \$712            | \$712              | 1.4       | \$300   | 1.3       | \$184  |

Table 17. 5-Story Cost-Effectiveness Results per Dwelling Unit: Mixed Fuel Efficiency

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |         | TDV       |         |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|---------|-----------|---------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV     | B/C Ratio | NPV     |
| CZ01         | PGE                   | 0%                         | 0%                 | 5                         | 0                           | \$2                  | \$39               | \$176            | \$176              | 0.2       | (\$137) | 0.2       | (\$136) |
| CZ02         | PGE                   | 1%                         | 0%                 | 11                        | 0                           | \$2                  | \$38               | \$132            | \$132              | 0.3       | (\$94)  | 1.9       | \$118   |
| CZ03         | PGE                   | 0%                         | 0%                 | 7                         | 0                           | \$2                  | \$46               | \$132            | \$132              | 0.3       | (\$86)  | 0.8       | (\$23)  |
| CZ04         | PGE                   | 1%                         | 0%                 | 12                        | 0                           | \$2                  | \$40               | \$132            | \$132              | 0.3       | (\$92)  | 1.9       | \$114   |
| CZ04         | CPAU                  | 1%                         | 0%                 | 12                        | 0                           | \$2                  | \$39               | \$132            | \$132              | 0.3       | (\$93)  | 1.9       | \$114   |
| CZ05         | PGE                   | 0%                         | 0%                 | 6                         | 0                           | \$1                  | \$17               | \$132            | \$132              | 0.1       | (\$114) | 0.4       | (\$73)  |
| CZ05         | PGE/SCG               | 0%                         | 0%                 | 6                         | 0                           | \$1                  | \$17               | \$132            | \$132              | 0.1       | (\$114) | 0.4       | (\$73)  |
| CZ06         | SCE/SCG               | 0%                         | 0%                 | 12                        | 0                           | \$2                  | \$51               | \$132            | \$132              | 0.4       | (\$81)  | 1.4       | \$49    |
| CZ07         | SDGE                  | 0%                         | 0%                 | 10                        | 0                           | \$0                  | \$0                | \$132            | \$132              | 0.0       | (\$132) | 0.9       | (\$7)   |
| CZ08         | SCE/SCG               | 1%                         | 0%                 | 24                        | 0                           | \$8                  | \$184              | \$132            | \$132              | 1.4       | \$53    | 2.2       | \$152   |
| CZ09         | SCE                   | 1%                         | 0%                 | 28                        | 0                           | \$4                  | \$96               | \$142            | \$149              | 0.6       | (\$52)  | 2.1       | \$163   |
| CZ10         | SCE/SCG               | 2%                         | 1%                 | 66                        | 0                           | \$21                 | \$491              | \$186            | \$192              | 2.6       | \$298   | 3.2       | \$425   |
| CZ10         | SDGE                  | 2%                         | 1%                 | 66                        | 0                           | \$30                 | \$751              | \$186            | \$192              | 3.9       | \$558   | 3.2       | \$425   |
| CZ11         | PGE                   | 2%                         | 1%                 | 83                        | 0                           | \$29                 | \$665              | \$186            | \$192              | 3.5       | \$473   | 4.2       | \$621   |
| CZ12         | PGE                   | 2%                         | 0%                 | 84                        | 0                           | \$29                 | \$681              | \$321            | \$414              | 1.6       | \$267   | 2.3       | \$546   |
| CZ12         | SMUD/PGE              | 2%                         | 0%                 | 84                        | 0                           | \$16                 | \$372              | \$321            | \$414              | 0.9       | (\$42)  | 2.3       | \$546   |
| CZ13         | PGE                   | 2%                         | 1%                 | 95                        | 0                           | \$33                 | \$765              | \$186            | \$192              | 4.0       | \$573   | 4.9       | \$742   |
| CZ14         | SCE/SCG               | 2%                         | 1%                 | 75                        | 0                           | \$11                 | \$246              | \$186            | \$192              | 1.3       | \$54    | 3.9       | \$561   |
| CZ14         | SDGE                  | 2%                         | 1%                 | 75                        | 0                           | \$34                 | \$847              | \$186            | \$192              | 4.4       | \$654   | 3.9       | \$561   |
| CZ15         | SCE/SCG               | 3%                         | 2%                 | 172                       | 0                           | \$55                 | \$1,257            | \$186            | \$192              | 6.5       | \$1,065 | 7.3       | \$1,212 |
| CZ16         | PG&E                  | 2%                         | 2%                 | 40                        | 4                           | \$23                 | \$616              | \$665            | \$665              | 0.9       | (\$49)  | 0.999     | (\$0)   |

#### 4.4 Mixed Fuel Plus PV (Plus Battery for the 3-Story Prototype)

Table 18 presents the Mixed Fuel Efficiency + PV + Battery package for the 3-story prototype. The battery system is a 100kWh battery. This scenario is cost-effective for all climate zones and under both metrics except for On-Bill in Climate Zone 4 in CPAU territory. Table 19 presents the Mixed Fuel Efficiency + PV package for the 5-story prototype. This package is cost-effective under TDV in all climate zones and cost-effective On-Bill everywhere except in Climate Zones 6 and 7. In the cases where it is not cost-effective, it is very close to being so with small negative NPV. In Climate Zone 6 in the 5-story prototype there is no upgrade to the PV system capacity as the prescriptive PV system already offset all of the estimated electricity use.

Table 18. 3-Story Cost-Effectiveness Results per Dwelling Unit: Mixed Fuel Efficiency + PV + Battery

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |           | TDV       |         |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|-----------|-----------|---------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV       | B/C Ratio | NPV     |
| CZ01         | PGE                   | 1%                         | 16%                | 2,068                     | 0                           | \$543                | \$12,588           | \$4,603          | \$6,917            | 1.8       | \$5,671   | 1.5       | \$3,724 |
| CZ02         | PGE                   | 1%                         | 16%                | 1,757                     | 0                           | \$462                | \$10,718           | \$3,881          | \$5,990            | 1.8       | \$4,728   | 1.6       | \$3,820 |
| CZ03         | PGE                   | 1%                         | 17%                | 1,624                     | 0                           | \$423                | \$9,797            | \$3,700          | \$5,754            | 1.7       | \$4,043   | 1.5       | \$3,157 |
| CZ04         | PGE                   | 1%                         | 17%                | 1,476                     | 0                           | \$383                | \$8,878            | \$3,518          | \$5,518            | 1.6       | \$3,360   | 1.6       | \$3,067 |
| CZ04         | CPAU                  | 1%                         | 17%                | 1,476                     | 0                           | \$171                | \$3,967            | \$3,518          | \$5,518            | 0.7       | (\$1,551) | 1.6       | \$3,067 |
| CZ05         | PGE                   | 1%                         | 18%                | 1,520                     | 0                           | \$393                | \$9,107            | \$3,503          | \$5,498            | 1.7       | \$3,609   | 1.6       | \$3,526 |
| CZ05         | PGE/SCG               | 1%                         | 18%                | 1,520                     | 0                           | \$393                | \$9,107            | \$3,503          | \$5,498            | 1.7       | \$3,609   | 1.6       | \$3,526 |
| CZ06         | SCE/SCG               | 1%                         | 18%                | 1,112                     | 0                           | \$336                | \$7,677            | \$3,127          | \$5,009            | 1.5       | \$2,668   | 1.4       | \$1,917 |
| CZ07         | SDGE                  | 0%                         | 20%                | 1,431                     | 0                           | \$550                | \$13,713           | \$3,498          | \$5,493            | 2.5       | \$8,220   | 1.6       | \$3,159 |
| CZ08         | SCE/SCG               | 1%                         | 18%                | 1,311                     | 0                           | \$413                | \$9,427            | \$3,328          | \$5,270            | 1.8       | \$4,156   | 1.4       | \$2,277 |
| CZ09         | SCE                   | 1%                         | 17%                | 1,129                     | 0                           | \$367                | \$8,375            | \$3,129          | \$5,017            | 1.7       | \$3,359   | 1.4       | \$1,937 |
| CZ10         | SCE/SCG               | 3%                         | 19%                | 1,342                     | 0                           | \$420                | \$9,584            | \$3,321          | \$5,254            | 1.8       | \$4,331   | 1.5       | \$2,588 |
| CZ10         | SDGE                  | 3%                         | 19%                | 1,342                     | 0                           | \$533                | \$13,303           | \$3,321          | \$5,254            | 2.5       | \$8,049   | 1.5       | \$2,588 |
| CZ11         | PGE                   | 3%                         | 17%                | 1,833                     | 0                           | \$500                | \$11,587           | \$3,914          | \$6,025            | 1.9       | \$5,562   | 1.6       | \$3,852 |
| CZ12         | PGE                   | 2%                         | 17%                | 1,701                     | 0                           | \$442                | \$10,239           | \$3,926          | \$6,105            | 1.7       | \$4,133   | 1.6       | \$3,583 |
| CZ12         | SMUD/PGE              | 2%                         | 17%                | 1,701                     | 0                           | \$285                | \$6,609            | \$3,926          | \$6,105            | 1.1       | \$503     | 1.6       | \$3,583 |
| CZ13         | PGE                   | 4%                         | 17%                | 1,568                     | 0                           | \$431                | \$9,983            | \$3,594          | \$5,609            | 1.8       | \$4,374   | 1.7       | \$3,944 |
| CZ14         | SCE/SCG               | 3%                         | 19%                | 1,556                     | 0                           | \$477                | \$10,886           | \$3,388          | \$5,341            | 2.0       | \$5,545   | 1.6       | \$3,434 |
| CZ14         | SDGE                  | 3%                         | 19%                | 1,556                     | 0                           | \$607                | \$15,155           | \$3,388          | \$5,341            | 2.8       | \$9,815   | 1.6       | \$3,434 |
| CZ15         | SCE/SCG               | 5%                         | 19%                | 1,241                     | 0                           | \$421                | \$9,616            | \$3,136          | \$5,013            | 1.9       | \$4,603   | 1.6       | \$3,076 |
| CZ16         | PG&E                  | 5%                         | 17%                | 1,286                     | 12                          | \$357                | \$8,508            | \$3,894          | \$5,833            | 1.5       | \$2,674   | 1.6       | \$3,219 |

Table 19. 5-Story Cost-Effectiveness Results per Dwelling Unit: Mixed Fuel Efficiency + PV

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |         | TDV       |         |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|---------|-----------|---------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV     | B/C Ratio | NPV     |
| CZ01         | PGE                   | 0%                         | 5%                 | 1,446                     | 0                           | \$341                | \$7,917            | \$1,889          | \$2,403            | 3.3       | \$5,514 | 3.0       | \$4,757 |
| CZ02         | PGE                   | 1%                         | 2%                 | 444                       | 0                           | \$55                 | \$1,275            | \$567            | \$697              | 1.8       | \$578   | 4.4       | \$2,365 |
| CZ03         | PGE                   | 0%                         | 4%                 | 693                       | 0                           | \$119                | \$2,766            | \$801            | \$1,002            | 2.8       | \$1,764 | 4.4       | \$3,423 |
| CZ04         | PGE                   | 1%                         | 1%                 | 112                       | 0                           | \$14                 | \$324              | \$226            | \$254              | 1.3       | \$69    | 3.5       | \$632   |
| CZ04         | CPAU                  | 1%                         | 1%                 | 112                       | 0                           | \$13                 | \$307              | \$226            | \$254              | 1.2       | \$53    | 3.5       | \$632   |
| CZ05         | PGE                   | 0%                         | 3%                 | 464                       | 0                           | \$56                 | \$1,310            | \$550            | \$676              | 1.9       | \$634   | 4.2       | \$2,165 |
| CZ05         | PGE/SCG               | 0%                         | 3%                 | 464                       | 0                           | \$56                 | \$1,310            | \$550            | \$676              | 1.9       | \$634   | 4.2       | \$2,165 |
| CZ06         | SCE/SCG               | 0%                         | 0%                 | 12                        | 0                           | \$2                  | \$51               | \$132            | \$132              | 0.4       | (\$81)  | 1.4       | \$49    |
| CZ07         | SDGE                  | 0%                         | 1%                 | 95                        | 0                           | \$0                  | \$0                | \$212            | \$237              | 0.0       | (\$237) | 2.8       | \$423   |
| CZ08         | SCE/SCG               | 1%                         | 3%                 | 299                       | 0                           | \$42                 | \$968              | \$388            | \$465              | 2.1       | \$504   | 4.3       | \$1,527 |
| CZ09         | SCE                   | 1%                         | 1%                 | 99                        | 0                           | \$12                 | \$284              | \$204            | \$230              | 1.2       | \$54    | 3.0       | \$465   |
| CZ10         | SCE/SCG               | 2%                         | 3%                 | 364                       | 0                           | \$57                 | \$1,296            | \$450            | \$536              | 2.4       | \$759   | 4.2       | \$1,720 |
| CZ10         | SDGE                  | 2%                         | 3%                 | 364                       | 0                           | \$103                | \$2,566            | \$450            | \$536              | 4.8       | \$2,030 | 4.2       | \$1,720 |
| CZ11         | PGE                   | 2%                         | 7%                 | 1,178                     | 0                           | \$281                | \$6,521            | \$1,276          | \$1,610            | 4.1       | \$4,911 | 4.8       | \$6,162 |
| CZ12         | PGE                   | 2%                         | 4%                 | 683                       | 0                           | \$120                | \$2,791            | \$898            | \$1,164            | 2.4       | \$1,627 | 4.2       | \$3,716 |
| CZ12         | SMUD/PGE              | 2%                         | 4%                 | 683                       | 0                           | \$102                | \$2,362            | \$898            | \$1,164            | 2.0       | \$1,198 | 4.2       | \$3,716 |
| CZ13         | PGE                   | 2%                         | 7%                 | 1,137                     | 0                           | \$274                | \$6,347            | \$1,179          | \$1,484            | 4.3       | \$4,863 | 4.8       | \$5,599 |
| CZ14         | SCE/SCG               | 2%                         | 2%                 | 266                       | 0                           | \$33                 | \$748              | \$342            | \$395              | 1.9       | \$353   | 4.7       | \$1,447 |
| CZ14         | SDGE                  | 2%                         | 2%                 | 266                       | 0                           | \$62                 | \$1,554            | \$342            | \$395              | 3.9       | \$1,158 | 4.7       | \$1,447 |
| CZ15         | SCE/SCG               | 3%                         | 5%                 | 567                       | 0                           | \$125                | \$2,851            | \$535            | \$646              | 4.4       | \$2,204 | 5.6       | \$2,994 |
| CZ16         | PG&E                  | 2%                         | 6%                 | 1,051                     | 4                           | \$237                | \$5,569            | \$1,601          | \$1,883            | 3.0       | \$3,686 | 3.1       | \$4,011 |

## 4.5 CARE Rate Comparison

Table 20 presents a comparison of On-Bill cost-effectiveness results for CARE tariffs relative to standard tariffs for the all-electric prescriptive code case. The CARE rates apply to the apartment meters only and don't impact the central water heating utility costs. Applying the CARE rates lowers both electric and gas utility bills for the consumer and the net impact for an all-electric building in most climate zones is lower overall bills and improved cost-effectiveness relative to the standard tariffs. Although not presented here, the all-electric + PV packages are all still On-Bill cost-effective using the CARE tariffs.

**Table 20. On-Bill IOU Cost-Effectiveness Comparison with CARE Tariffs, Results per Dwelling Unit: All-Electric Prescriptive Code**

| Climate Zone | Electric /Gas Utility | 3-Story   |           |           |           | 5-Story   |           |           |           |
|--------------|-----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|              |                       | Standard  |           | CARE      |           | Standard  |           | CARE      |           |
|              |                       | B/C Ratio | NPV       | B/C Ratio | NPV       | B/C Ratio | NPV       | B/C Ratio | NPV       |
| CZ01         | PGE                   | 3.9       | \$1,247   | 9.5       | \$3,637   | >1        | \$6,998   | >1        | \$10,045  |
| CZ02         | PGE                   | 1.0       | \$32      | 3.1       | \$2,139   | 0.7       | (\$375)   | 2.5       | \$1,831   |
| CZ03         | PGE                   | 1.1       | \$119     | 3.1       | \$2,187   | 0.7       | (\$407)   | 2.6       | \$1,901   |
| CZ04         | PGE                   | 0.9       | (\$108)   | 2.8       | \$1,884   | 1.8       | \$945     | 2.9       | \$2,218   |
| CZ05         | PGE                   | 0.98      | (\$21)    | 3.0       | \$2,041   | 0.6       | (\$479)   | 2.5       | \$1,773   |
| CZ05         | PGE/SCG               | 0.0       | (\$1,545) | 1.5       | \$517     | 0.0       | (\$2,103) | 1.1       | \$148     |
| CZ06         | SCE/SCG               | 0.0       | (\$1,255) | 0.9       | (\$57)    | 0.8       | (\$199)   | 2.1       | \$1,349   |
| CZ07         | SDGE                  | 0.0       | (\$1,456) | 1.8       | \$856     | 0.0       | (\$1,685) | 1.3       | \$343     |
| CZ08         | SCE/SCG               | 0.0       | (\$1,331) | 0.8       | (\$165)   | 0.0       | (\$1,829) | 1.2       | \$271     |
| CZ09         | SCE                   | 0.0       | (\$1,380) | 0.8       | (\$204)   | 0.0       | (\$1,236) | 1.6       | \$750     |
| CZ10         | SCE/SCG               | 0.0       | (\$1,758) | 0.1       | (\$574)   | 0.0       | (\$2,445) | 0.5       | (\$447)   |
| CZ10         | SDGE                  | 0.0       | (\$2,452) | 0.8       | (\$162)   | 0.0       | (\$3,234) | 0.0       | (\$1,590) |
| CZ11         | PGE                   | 0.0       | (\$826)   | 2.7       | \$1,119   | 0.0       | (\$1,494) | 1.7       | \$616     |
| CZ12         | PGE                   | 0.0       | (\$719)   | 2.9       | \$1,263   | 0.0       | (\$1,358) | 2.0       | \$793     |
| CZ13         | PGE                   | 0.0       | (\$940)   | 2.4       | \$936     | 0.0       | (\$1,517) | 1.6       | \$491     |
| CZ14         | SCE/SCG               | 0.0       | (\$2,063) | 0.0       | (\$803)   | 0.0       | (\$2,916) | 0.3       | (\$613)   |
| CZ14         | SDGE                  | 0.0       | (\$2,841) | 0.0       | (\$3,407) | 0.0       | (\$3,937) | 1.1       | \$61      |
| CZ15         | SCE/SCG               | 0.0       | (\$2,053) | 0.0       | (\$1,036) | 0.0       | (\$2,606) | 0.0       | (\$1,452) |
| CZ16         | PG&E                  | 2.8       | \$1,917   | >1        | \$5,527   | 9.1       | \$5,467   | >1        | \$8,557   |

**Error! Not a valid bookmark self-reference.** presents the comparison for the mixed fuel efficiency and PV packages. Generally, the opposite trend occurs here for the mixed fuel packages where the CARE rate lowers utility cost savings and the benefit-to-cost ratios decline.

**Table 21. On-Bill IOU Cost-Effectiveness Comparison with CARE Tariffs, Results per Dwelling Unit: Mixed Fuel Packages**

| Climate Zone | Electric /Gas Utility | 3-Story (Efficiency + PV + Battery) |         |           |         | 5-Story (Efficiency + PV) |         |           |         |
|--------------|-----------------------|-------------------------------------|---------|-----------|---------|---------------------------|---------|-----------|---------|
|              |                       | Standard                            |         | CARE      |         | Standard                  |         | CARE      |         |
|              |                       | B/C Ratio                           | NPV     | B/C Ratio | NPV     | B/C Ratio                 | NPV     | B/C Ratio | NPV     |
| CZ01         | PGE                   | 1.8                                 | \$5,671 | 1.2       | \$1,113 | 3.3                       | \$5,514 | 2.2       | \$2,765 |
| CZ02         | PGE                   | 1.8                                 | \$4,728 | 1.2       | \$907   | 1.8                       | \$578   | 1.5       | \$337   |
| CZ03         | PGE                   | 1.7                                 | \$4,043 | 1.1       | \$579   | 2.8                       | \$1,764 | 2.0       | \$1,028 |
| CZ04         | PGE                   | 1.6                                 | \$3,360 | 1.0       | \$259   | 1.3                       | \$69    | 0.8       | (\$44)  |
| CZ05         | PGE                   | 1.7                                 | \$3,609 | 1.1       | \$414   | 1.9                       | \$634   | 1.7       | \$442   |
| CZ05         | PGE/SCG               | 1.7                                 | \$3,609 | 1.1       | \$414   | 1.9                       | \$634   | 1.7       | \$442   |
| CZ06         | SCE/SCG               | 1.5                                 | \$2,668 | 0.9       | (\$515) | 0.4                       | (\$81)  | 0.3       | (\$92)  |
| CZ07         | SDGE                  | 2.5                                 | \$8,220 | 1.7       | \$4,106 | 0.0                       | (\$237) | 0.0       | (\$237) |
| CZ08         | SCE/SCG               | 1.8                                 | \$4,156 | 1.1       | \$446   | 2.1                       | \$504   | 1.3       | \$137   |
| CZ09         | SCE                   | 1.7                                 | \$3,359 | 0.99      | (\$26)  | 1.2                       | \$54    | 0.9       | (\$28)  |
| CZ10         | SCE/SCG               | 1.8                                 | \$4,331 | 1.1       | \$577   | 2.4                       | \$759   | 1.3       | \$180   |
| CZ10         | SDGE                  | 2.5                                 | \$8,049 | 1.8       | \$4,180 | 4.8                       | \$2,030 | 0.0       | (\$536) |
| CZ11         | PGE                   | 1.9                                 | \$5,562 | 1.2       | \$1,435 | 4.1                       | \$4,911 | 2.7       | \$2,744 |
| CZ12         | PGE                   | 1.7                                 | \$4,133 | 1.1       | \$517   | 2.4                       | \$1,627 | 1.8       | \$905   |
| CZ13         | PGE                   | 1.8                                 | \$4,374 | 1.2       | \$883   | 4.3                       | \$4,863 | 2.9       | \$2,777 |
| CZ14         | SCE/SCG               | 2.0                                 | \$5,545 | 1.3       | \$1,395 | 1.9                       | \$353   | 1.3       | \$136   |
| CZ14         | SDGE                  | 2.8                                 | \$9,815 | 1.4       | \$2,292 | 3.9                       | \$1,158 | 0.0       | (\$395) |
| CZ15         | SCE/SCG               | 1.9                                 | \$4,603 | 1.2       | \$887   | 4.4                       | \$2,204 | 1.9       | \$586   |
| CZ16         | PG&E                  | 1.5                                 | \$2,674 | 0.97      | (\$162) | 3.0                       | \$3,686 | 2.0       | \$1,908 |

## 4.6 Greenhouse Gas Reductions

Figure 1 and Figure 2 compare greenhouse gas reductions across all the packages for the multifamily 3-story and 5-story prototypes, respectively. Savings represent average annual savings per dwelling unit over the 30-year lifetime of the analysis. Electrification of gas uses represents the greatest greenhouse gas reductions, followed by PV. Greenhouse gas reductions are greatest for the all-electric + PV package.

Figure 1. 3-Story greenhouse gas reductions (metric tons) per dwelling unit

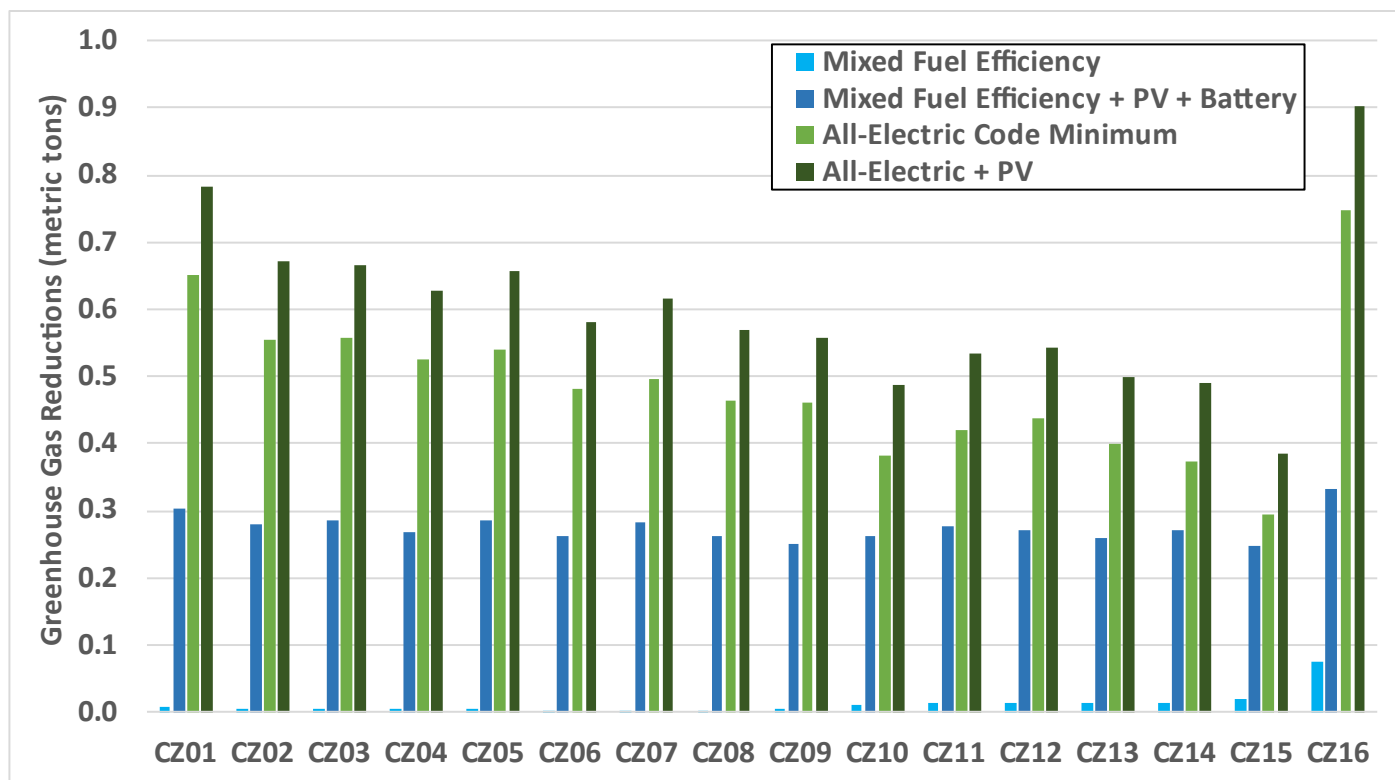
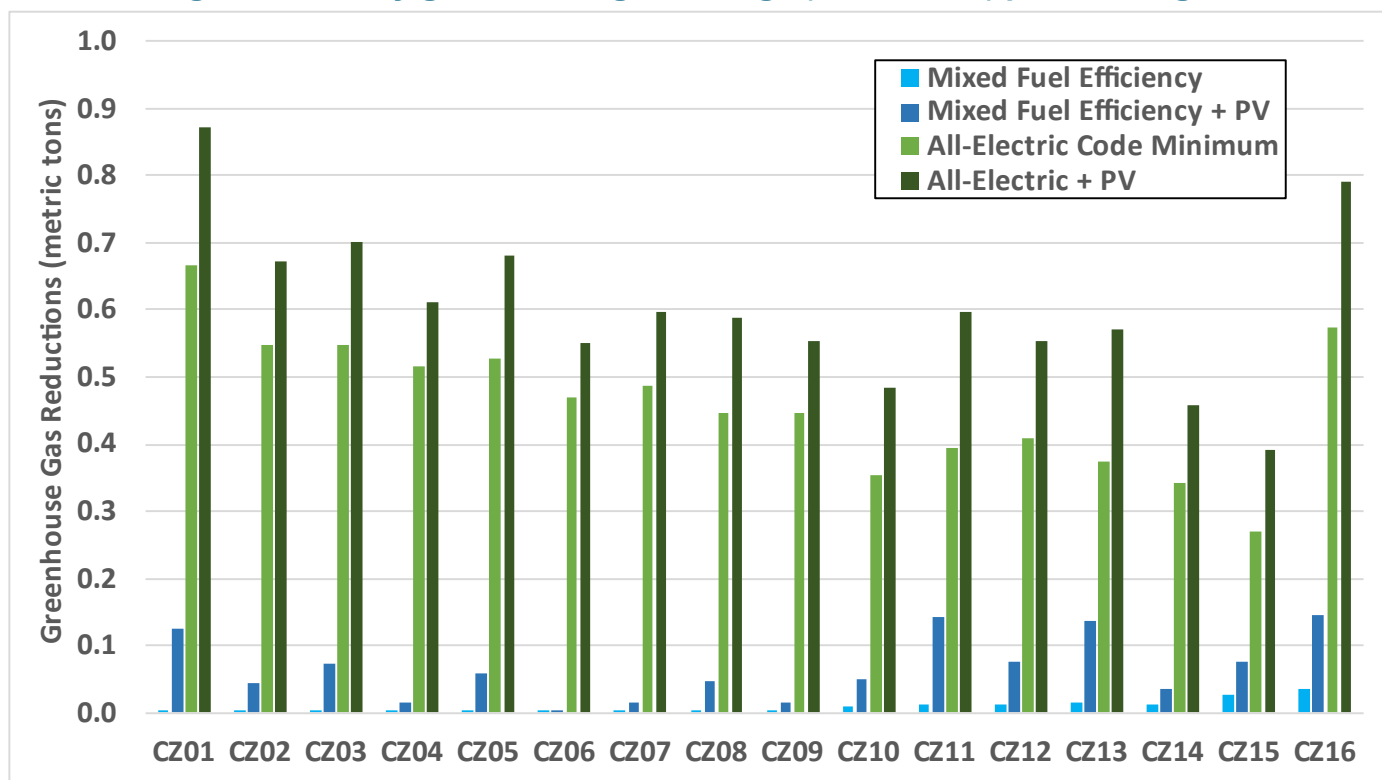


Figure 2. 5-Story greenhouse gas savings (metric tons) per dwelling unit



## 5 Summary

The Reach Codes Team identified packages of electrification and energy efficiency measures as well as packages combining these measures with solar PV generation and battery storage, simulated them using building modeling software, and gathered costs to determine the cost-effectiveness of multiple scenarios. The Reach Codes Team coordinated with multiple utilities, cities, and building community experts to develop a set of assumptions considered reasonable in the current market. Changing assumptions, such as the period of analysis, measure selection, cost assumptions, energy escalation rates, or utility tariffs are likely to change results.

Table 22 summarizes results for each prototype and depicts the efficiency TDV compliance margins achieved for each climate zone and package. Because local reach codes must both exceed the Energy Commission performance budget (i.e., have a positive compliance margin) and be cost-effective, the Reach Codes Team highlighted cells meeting these two requirements to help clarify the upper boundary for potential reach code policies. All results presented in this study have a positive compliance margin.

- Cells highlighted in **green** depict cases with a positive compliance margin and cost-effective results using both On-Bill and TDV approaches.
- Cells highlighted in **yellow** depict cases with a positive compliance margin and cost-effective results using either the On-Bill or TDV approach.
- Cells **not highlighted** depict cases with a positive compliance margin but that were not cost-effective using either the On-Bill or TDV approach.

Following are key takeaways and recommendations from the analysis.

- The Reach Codes Team found all-electric new construction to be feasible and cost-effective based on the California Energy Commission's Time Dependent Valuation (TDV) metric in all cases. In many cases all-electric prescriptive code construction results in an increase in utility costs and is not cost-effective On-Bill. Some exceptions include the SMUD and CPAU territories where lower electricity rates relative to gas rates result in lower overall utility bills.
- All-electric packages have lower GHG emissions than mixed fuel packages in all cases, due to the clean power sources currently available from California's power providers.
- The 2022 Energy Code's new source energy metric combined with the heat pump space heating baseline in most climate zones encourages all-electric construction. While the code does not include an electric baseline for water heating, the penalty for central electric water heating observed in the performance approach in past code cycles has been removed and a credit is provided for well-designed central heat pump water heaters in most cases.
- Electrification combined with increased PV capacity results in utility cost savings and was found to be On-Bill cost-effective in all cases.
- The results in this study are based on today's net energy metering (NEM 2.0) rules and do not account for recently approved changes to the NEM tariff (referred to as the net billing tariff). The net billing tariff decreases the value of PV to the consumer as compared to NEM 2.0. As a result, the cost-effectiveness of the packages that include above-code PV capacity is expected to be less under the net billing tariff. Conversely, the net billing tariff is expected to increase On-Bill cost-effectiveness of the all-electric prescriptive code scenario. An all-electric home has better on-site utilization of generated electricity from PV than a mixed fuel home with a similar sized PV system, and as a result exports less electricity to the grid. Since the net-billing tariff values exports less than under NEM 2.0, the relative impact on annual utility costs to the mixed fuel baseline is greater.
- This analysis does justify requiring a modest reach based on either efficiency TDV or source energy for all-electric buildings. However, this may be challenging for some projects given the recent changes to which the industry must adapt, including the efficiency updates and multifamily restructuring in the 2022 Title 24, Part 6 code. While project compliance margins using a CO<sub>2</sub> refrigerant heat pump water heating system are high, the Reach Code Team found lower compliance margins using other heat pump water heater system designs.

Focusing on supporting projects to electrify water heating is expected to support the market shift towards more central heat pump water heaters.

- For jurisdictions interested in a reach code that allows for mixed fuel buildings, a mixed fuel efficiency and PV package (and battery for the 3-story prototype) was found to be cost-effective based on TDV in all cases and cost-effective On-Bill in most climate zones. This path, referred to as “Electric-Preferred”, allows for mixed fuel buildings but requires a higher building performance than for all-electric buildings. The efficiency measures evaluated in this study did not provide significant compliance benefit. As a result, the Reach Codes Team recommends establishing a compliance margin target based on source energy or total TDV. This would allow for PV and battery above minimum code requirements to be used to meet the target.
- Jurisdictions interested in increasing affordable multifamily housing should know that applying the CARE rates has the overall impact of increasing utility cost savings for an all-electric building in most climate zones compared to a code compliant mixed fuel building, improving On-Bill cost-effectiveness.

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. Reach codes that amend Part 6 of the California 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.

**Table 22. Summary of Efficiency TDV Compliance Margins and Cost-Effectiveness**

| Climate Zone | Electric /Gas Utility | 3-Story                        |                   |                       |                                      | 5-Story                        |                   |                       |                            |
|--------------|-----------------------|--------------------------------|-------------------|-----------------------|--------------------------------------|--------------------------------|-------------------|-----------------------|----------------------------|
|              |                       | All-Electric Prescriptive Code | All-Electric + PV | Mixed Fuel Efficiency | Mixed Fuel Efficiency + PV + Battery | All-Electric Prescriptive Code | All-Electric + PV | Mixed Fuel Efficiency | Mixed Fuel Efficiency + PV |
| CZ01         | PGE                   | 26%                            | 26%               | 1%                    | 1%                                   | 14%                            | 14%               | 0%                    | 0%                         |
| CZ02         | PGE                   | 20%                            | 20%               | 1%                    | 1%                                   | 9%                             | 9%                | 1%                    | 1%                         |
| CZ03         | PGE                   | 21%                            | 21%               | 1%                    | 1%                                   | 11%                            | 11%               | 0%                    | 0%                         |
| CZ04         | PGE                   | 18%                            | 18%               | 1%                    | 1%                                   | 9%                             | 9%                | 1%                    | 1%                         |
| CZ04         | CPAU                  | 18%                            | 18%               | 1%                    | 1%                                   | 9%                             | 9%                | 1%                    | 1%                         |
| CZ05         | PGE                   | 23%                            | 23%               | 1%                    | 1%                                   | 12%                            | 12%               | 0%                    | 0%                         |
| CZ05         | PGE/SCG               | 23%                            | 23%               | 1%                    | 1%                                   | 12%                            | 12%               | 0%                    | 0%                         |
| CZ06         | SCE/SCG               | 18%                            | 18%               | 1%                    | 1%                                   | 9%                             | 9%                | 0%                    | 0%                         |
| CZ07         | SDGE                  | 20%                            | 20%               | 0%                    | 0%                                   | 11%                            | 11%               | 0%                    | 0%                         |
| CZ08         | SCE/SCG               | 13%                            | 13%               | 1%                    | 1%                                   | 8%                             | 8%                | 1%                    | 1%                         |
| CZ09         | SCE                   | 13%                            | 13%               | 1%                    | 1%                                   | 7%                             | 7%                | 1%                    | 1%                         |
| CZ10         | SCE/SCG               | 14%                            | 14%               | 3%                    | 3%                                   | 7%                             | 7%                | 2%                    | 2%                         |
| CZ10         | SDGE                  | 14%                            | 14%               | 3%                    | 3%                                   | 7%                             | 7%                | 2%                    | 2%                         |
| CZ11         | PGE                   | 14%                            | 14%               | 3%                    | 3%                                   | 8%                             | 8%                | 2%                    | 2%                         |
| CZ12         | PGE                   | 17%                            | 17%               | 2%                    | 2%                                   | 9%                             | 9%                | 2%                    | 2%                         |
| CZ12         | SMUD/PGE              | 17%                            | 17%               | 2%                    | 2%                                   | 9%                             | 9%                | 2%                    | 2%                         |
| CZ13         | PGE                   | 13%                            | 13%               | 4%                    | 4%                                   | 7%                             | 7%                | 2%                    | 2%                         |
| CZ14         | SCE/SCG               | 13%                            | 13%               | 3%                    | 3%                                   | 6%                             | 6%                | 2%                    | 2%                         |
| CZ14         | SDGE                  | 13%                            | 13%               | 3%                    | 3%                                   | 6%                             | 6%                | 2%                    | 2%                         |
| CZ15         | SCE/SCG               | 5%                             | 5%                | 5%                    | 5%                                   | 3%                             | 3%                | 3%                    | 3%                         |
| CZ16         | PG&E                  | 24%                            | 24%               | 5%                    | 5%                                   | 9%                             | 9%                | 2%                    | 2%                         |

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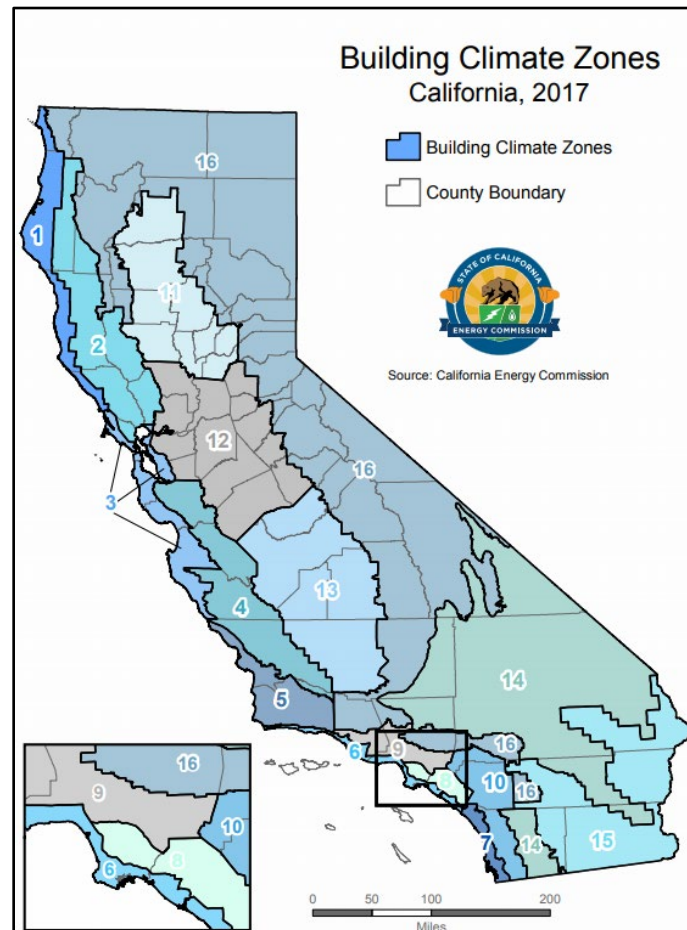
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## 7 Appendices

### 7.1 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](https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html)

**Figure 3. Map of California climate zones.**



## 7.2 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 2022 credits shows below.<sup>9</sup> The credits were applied to reduce the total calculated annual bill, including any fixed fees or minimum bill amounts.

### 2022 Electric California Climate Credit Schedule

|                  | April   | May | June | July | Aug     | Sept    | Oct     |
|------------------|---------|-----|------|------|---------|---------|---------|
| <b>PG&amp;E</b>  | \$39.30 |     |      |      |         |         | \$39.30 |
| <b>SCE</b>       | \$59.00 |     |      |      |         |         | \$59.00 |
| <b>SDG&amp;E</b> |         |     |      |      | \$64.17 | \$64.17 |         |

## Residential Natural Gas California Climate Credit

The 2022 Natural Gas California Climate Credit is distributed in April.

|                      | 2018 <sup>†</sup> | 2019 | 2020 | 2021 | 2022    | Total Value Received Per Household 2018-2022 |
|----------------------|-------------------|------|------|------|---------|--|
| <b>PG&amp;E</b>      | \$30              | \$25 | \$27 | \$25 | \$47.83 | <b>\$154</b>                                 |
| <b>SDG&amp;E</b>     | *                 | \$34 | \$21 | \$18 | \$43.06 | <b>\$116</b>                                 |
| <b>Southwest Gas</b> | \$22              | \$25 | \$27 | \$28 | \$49.44 | <b>\$150</b>                                 |
| <b>SoCalGas</b>      | *                 | \$50 | \$26 | \$22 | \$44.17 | <b>\$142</b>                                 |

Electricity rates reflect the most recent approved tariffs. Monthly gas rates were estimated based on the latest available gas rate (December 2022) 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 2012 and 2022 (between 2020 and 2022 for CPAU). 12-month curves were created from monthly gas rates for each of the eleven years (three 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 (December 2022), and then using the normalized curve to estimate the cost for the remaining months relative to the reference point rate.

<sup>9</sup> <https://www.cpuc.ca.gov/industries-and-topics/natural-gas/greenhouse-gas-cap-and-trade-program/california-climate-credit>

## 7.2.1 Pacific Gas & Electric

The following pages provide details on the PG&E electricity and natural gas tariffs applied in this study. **Error! Reference source not found.** describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of \$0.0474/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between November 2021 and October 2022.

**Table 23. 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 **Error! Reference source not found.** These are applied to both the G-1 and GM rates. These rates are based on applying a normalization curve to the December 2022 tariff based on eleven years of historical gas data. See the beginning of Section **Error! Reference source not found.** **Error! Reference source not found.** for further details. The corresponding CARE rates are shown in **Error! Reference source not found.** and reflect the 20 percent discount per the GL-1 tariff. The GM master metered water heating baseline quantity of 0.43 therms per dwelling unit per day in all baseline territories and in both seasons was applied to the centrally metered gas water heating.

**Table 24. PG&E Monthly Gas Rate (\$/therm)**

| Month     | Total Charge |           |
|-----------|--------------|-----------|
|           | Baseline     | Excess    |
| January   | \$2.20579    | \$2.66008 |
| February  | \$2.24291    | \$2.69637 |
| March     | \$2.11750    | \$2.58278 |
| April     | \$2.08101    | \$2.55500 |
| May       | \$2.08062    | \$2.55844 |
| June      | \$2.09104    | \$2.56928 |
| July      | \$2.10404    | \$2.58189 |
| August    | \$2.15162    | \$2.63251 |
| September | \$2.18718    | \$2.67910 |
| October   | \$2.23153    | \$2.71934 |
| November  | \$2.32121    | \$2.79158 |
| December  | \$2.34123    | \$2.80922 |

**Table 25. PG&E Monthly CARE (GL-1) Gas Rate (\$/therm)**

| Month     | Total CARE Charge |           |
|-----------|-------------------|-----------|
|           | Baseline          | Excess    |
| January   | \$1.76463         | \$2.12806 |
| February  | \$1.79433         | \$2.15710 |
| March     | \$1.69400         | \$2.06622 |
| April     | \$1.66480         | \$2.04400 |
| May       | \$1.66449         | \$2.04675 |
| June      | \$1.67283         | \$2.05543 |
| July      | \$1.68323         | \$2.06551 |
| August    | \$1.72129         | \$2.10601 |
| September | \$1.74974         | \$2.14328 |
| October   | \$1.78523         | \$2.17547 |
| November  | \$1.85697         | \$2.23327 |
| December  | \$1.87298         | \$2.24738 |

## Residential GAS

### Baseline Territories and Quantities <sup>1/</sup>

**Effective April 1, 2022 - Present**

BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)

| Individually Metered |  |   |   |
|----------------------|--|---|---|
| Baseline Territories | Summer (April-October)<br>Effective Apr. 1, 2022 | Winter Off-Peak (Nov, Feb, Mar)<br>Effective Nov. 1, 2022 | Winter On-Peak (Dec, Jan)<br>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)<br>Effective Apr. 1, 2022 | Winter Off-Peak (Nov, Feb, Mar)<br>Effective Nov. 1, 2022 | Winter On-Peak (Dec, Jan)<br>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

Advice Letter: 4589-G  
Decision 21-11-016  
GRC 2020 Ph II [Application 19-11-019]  
Filed: Nov 22, 2019



**Pacific Gas and  
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U 39

San Francisco, California

Cancelling Revised Cal. P.U.C. Sheet No. 53472-E  
Revised Cal. P.U.C. Sheet No. 52702-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**

(T)

| Total Energy Rates (\$ per kWh)   | PEAK        |     | OFF-PEAK    |     |
|---|-------------|-----|-------------|-----|
| <i>Summer</i>   |             |     |             |     |
| Total Usage   | \$0.48902   | (I) | \$0.42558   | (I) |
| Baseline Credit (Applied to Baseline Usage Only)  | (\$0.09054) | (R) | (\$0.09054) | (R) |
| <i>Winter</i>   |             |     |             |     |
| Total Usage   | \$0.39193   | (I) | \$0.37460   | (I) |
| Baseline Credit (Applied to Baseline Usage Only)  | (\$0.09054) | (R) | (\$0.09054) | (R) |
| Delivery Minimum Bill Amount (\$ per meter per day)   | \$0.34810   |     |             |     |
| California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles) | (\$39.30)   |     |             |     |

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)

|          |          |                                    |            |              |
|----------|----------|------------------------------------|------------|--------------|
| Advice   | 6603-E-A | Issued by                          | Submitted  | May 31, 2022 |
| Decision |          | <b>Robert S. Kenney</b>            | Effective  | June 1, 2022 |
|          |          | Vice President, Regulatory Affairs | Resolution |              |



**Pacific Gas and  
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U 39

San Francisco, California

Cancelling  
Revised

Revised  
Revised

Cal. P.U.C. Sheet No.  
Cal. P.U.C. Sheet No.

53474-E  
50175-E

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

Sheet 4

**SPECIAL  
CONDITIONS:**

1. **BASELINE (TIER 1) QUANTITIES:** The following quantities of electricity are to be used to define usage eligible for the baseline credit:

| BASELINE QUANTITIES (kWh PER DAY) |                           |     |        |     |                                     |     |        |     |
|-----------------------------------|---------------------------|-----|--------|-----|-------------------------------------|-----|--------|-----|
| Baseline<br>Territory*            | Code B - Basic Quantities |     |        |     | Code H - All-Electric<br>Quantities |     |        |     |
|                                   | Summer                    |     | Winter |     | Summer                              |     | Winter |     |
|                                   | Tier 1                    |     | Tier 1 |     | Tier 1                              |     | Tier 1 |     |
| P                                 | 13.5                      | (R) | 11.0   | (R) | 15.2                                | (R) | 26.0   | (R) |
| Q                                 | 9.8                       | (R) | 11.0   | (R) | 8.5                                 | (R) | 26.0   | (R) |
| R                                 | 17.7                      | (R) | 10.4   | (R) | 19.9                                | (R) | 26.7   | (R) |
| S                                 | 15.0                      | (R) | 10.2   | (R) | 17.8                                | (R) | 23.7   | (R) |
| T                                 | 6.5                       | (R) | 7.5    | (R) | 7.1                                 | (R) | 12.9   | (R) |
| V                                 | 7.1                       | (R) | 8.1    | (R) | 10.4                                | (R) | 19.1   | (I) |
| W                                 | 19.2                      | (R) | 9.8    | (R) | 22.4                                | (R) | 19.0   | (R) |
| X                                 | 9.8                       | (R) | 9.7    | (R) | 8.5                                 | (R) | 14.6   | (R) |
| Y                                 | 10.5                      | (R) | 11.1   | (R) | 12.0                                | (R) | 24.0   | (R) |
| Z                                 | 5.9                       | (R) | 7.8    | (R) | 6.7                                 | (R) | 15.7   | (R) |

2. **TIME PERIODS FOR E-TOU-C:** Times of the year and times of the day are defined as follows:

Summer (service from June 1 through September 30):

Peak: 4:00 p.m. to 9:00 p.m. All days

Off-Peak: All other times

Winter (service from October 1 through May 31):

Peak: 4:00 p.m. to 9:00 p.m. All days

Off-Peak: All other times

\* The applicable baseline territory is described in Part A of the Preliminary Statement

(Continued)

|          |          |                                    |            |              |
|----------|----------|------------------------------------|------------|--------------|
| Advice   | 6603-E-A | Issued by                          | Submitted  | May 31, 2022 |
| Decision |          | <b>Robert S. Kenney</b>            | Effective  | June 1, 2022 |
|          |          | Vice President, Regulatory Affairs | Resolution |              |



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Cal. P.U.C. Sheet No. 53424-E  
Cal. P.U.C. Sheet No. 52653-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, 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 will receive a percentage discount ("A" below) on their total bundled charges on their otherwise applicable rate schedule (except for the California Climate Credit, which will not be discounted). In addition, customers will receive a percentage discount ("B" 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. (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.

- |   |                    |     |
|---|--------------------|-----|
| A. D-CARE Discount:                             | 34.947 % (Percent) | (I) |
| B. Delivery Minimum Bill Discount:              | 50.000 % (Percent) |     |
| C. Master-Meter D-CARE Discount:                | 34.947 % (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.

(Continued)

|          |          |                                    |            |              |
|----------|----------|------------------------------------|------------|--------------|
| Advice   | 6603-E-A | Issued by                          | Submitted  | May 31, 2022 |
| Decision |          | <b>Robert S. Kenney</b>            | Effective  | June 1, 2022 |
|          |          | Vice President, Regulatory Affairs | Resolution |              |

## 7.2.2 Southern California Edison

The following pages provide details on are the SCE electricity tariffs applied in this study. **Error! Reference source not found.** describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of \$ 0.04361/ kWh was applied to any net annual electricity generation based on a one-year average of the rates between November 2021 and October 2022

**Table 26: 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

- Applicable rate time periods are defined as follows:

Option 4-9 PM, Option 4-9 PM-CPP, Option PRIME, Option PRIME-CPP :

| 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             |

(T)



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

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Revised  
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Cal. PUC Sheet No. 74502-E  
 Cal. PUC Sheet No. 73968-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<br>Total <sup>1</sup> | Generation <sup>2</sup> |                    |
|---|--|-------------------------|--------------------|
|   |  | UG <sup>3</sup>         | DWREC <sup>4</sup> |
| <b>Option 4-9 PM / Option 4-9 PM-CPP</b>            |  |                         |                    |
| Energy Charge - \$/kWh                              |  |                         |                    |
| Summer Season - On-Peak                             | 0.29820 (R)                            | 0.23706 (I)             | 0.00000            |
| Mid-Peak  | 0.29820 (R)                            | 0.13648 (I)             | 0.00000            |
| Off-Peak  | 0.25471 (I)                            | 0.07939 (R)             | 0.00000            |
| Winter Season - Mid-Peak                            | 0.29820 (R)                            | 0.17235 (I)             | 0.00000            |
| Off-Peak  | 0.25471 (I)                            | 0.10198 (R)             | 0.00000            |
| Super-Off-Peak                                      | 0.23907 (I)                            | 0.08508 (I)             | 0.00000            |
| Baseline Credit**** - \$/kWh                        | (0.09086) (I)                          | 0.00000                 |                    |
| Fixed Recovery Charge - \$/kWh                      | 0.00117 (I)                            |                         |                    |
| <b>Basic Charge - \$/day</b>                        |  |                         |                    |
| Single-Family Residence                             | 0.031                                  |                         |                    |
| Multi-Family Residence                              | 0.024                                  |                         |                    |
| <b>Minimum Charge** - \$/day</b>                    |  |                         |                    |
| Single Family Residence                             | 0.346                                  |                         |                    |
| Multi-Family Residence                              | 0.346                                  |                         |                    |
| <b>Minimum Charge (Medical Baseline)** - \$/day</b> |  |                         |                    |
| Single Family Residence                             | 0.173                                  |                         |                    |
| Multi-Family Residence                              | 0.173                                  |                         |                    |
| California Climate Credit <sup>15</sup>             | (\$9.00)                               |                         |                    |
| <b>California Alternate Rates for</b>               |  |                         |                    |
| Energy Discount - %                                 | 100.00 <sup>8</sup>                    |                         |                    |
| Family Electric Rate Assistance Discount -          | 100.00                                 |                         |                    |
| <b>Option 4-9 PM-CPP</b>                            |  |                         |                    |
| CPP Event Energy Charge - \$/kWh                    |  | 0.80000                 |                    |
| Summer CPP Non-Event Credit                         |  |                         |                    |
| On-Peak Energy Credit - \$/kWh                      |  | (0.15170)               |                    |
| <b>Maximum Available Credit - \$/kWh****</b>        |  |                         |                    |
| Summer Season                                       |  | (0.50662) (I)           |                    |

<sup>1</sup> Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.

<sup>2</sup> The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.

<sup>3</sup> The ongoing Competition Transition Charge (CTC) of (\$0.00019) per kWh is recovered in the UG component of Generation.

<sup>4</sup> The Baseline Credit applies up to 100% of the Baseline Allocation, regardless of Time-of-Use time period. Additional Baseline Allocations apply for (R)

Customers with Heat Pump Water Heaters served under this Option. The Baseline Allocations are set forth in Preliminary Statement, Part H. (T)

<sup>5</sup> The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs. (T)

<sup>6</sup> 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-CRB or Schedule CCA-CRB.

<sup>7</sup> Generation = The Gen rates are applicable only to Bundled Service Customers. See Special Condition below for PCA recovery.

<sup>8</sup> 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.

<sup>9</sup> Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 4864-E  
 Decision 22-08-001

2017

Issued by  
 Michael Backstrom  
 Vice President

(To be inserted by Cal. PUC)

Date Submitted Sep 15, 2022  
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 Resolution



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

Revised Cal. PUC Sheet No. 74493-E  
Cancelling Revised Cal. PUC Sheet No. 73964-E

Schedule D-CARE  
CALIFORNIA ALTERNATE RATES FOR ENERGY  
DOMESTIC SERVICE

Sheet 1

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 28.9 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 \$0.00931 per kWh and the Wildfire Fund Non-Bypassable Charge of \$0.00652 per kWh. The 28.9 percent discount, in addition to these exemptions result in an average effective CARE Discount of 32.5 percent.

(Continued)

(To be inserted by utility)

Advice 4864-E  
Decision 22-08-001

10/10

Issued by  
Michael Backstrom  
Vice President

(To be inserted by Cal. PUC)

Date Submitted Sep 15, 2022  
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Resolution \_\_\_\_\_

## 7.2.3 Southern California Gas

Following are the SoCalGas natural gas tariffs applied in this study. **Error! Reference source not found.** describes the baseline territories that were assumed for each climate zone.

**Table 27. 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 **Error! Reference source not found.** These rates are based on applying a normalization curve to the December 2022 tariff based on eleven years of historical gas data. See the beginning of Section **Error! Reference source not found.** **Error! Reference source not found.** for further details. Long-term historical natural gas rate data was only available for SoCalGas' procurement charges.<sup>10</sup> 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 2022 rates. CARE rates reflect the 20 percent discount per the GR tariff.

**Table 28. SoCalGas Monthly Gas Rate (\$/therm)**

| Month     | Procurement Charge | Transportation Charge |           | Total Charge |           |
|-----------|--------------------|-----------------------|-----------|--------------|-----------|
|           |                    | Baseline              | Excess    | Baseline     | Excess    |
| January   | \$0.90581          | \$0.82487             | \$1.23877 | \$1.73068    | \$2.14458 |
| February  | \$0.83669          | \$0.82487             | \$1.23877 | \$1.66156    | \$1.84967 |
| March     | \$0.80596          | \$0.82487             | \$1.23877 | \$1.63083    | \$1.82938 |
| April     | \$0.71941          | \$0.82487             | \$1.23877 | \$1.54428    | \$1.75890 |
| May       | \$0.77049          | \$0.82487             | \$1.23877 | \$1.59536    | \$1.78548 |
| June      | \$0.86253          | \$0.82487             | \$1.23877 | \$1.68740    | \$1.83337 |
| July      | \$0.87687          | \$0.82487             | \$1.23877 | \$1.70174    | \$1.86833 |
| August    | \$0.95391          | \$0.82487             | \$1.23877 | \$1.77878    | \$1.91089 |
| September | \$0.85896          | \$0.82487             | \$1.23877 | \$1.68383    | \$1.83611 |
| October   | \$0.84147          | \$0.82487             | \$1.23877 | \$1.66634    | \$1.84936 |
| November  | \$0.89018          | \$0.82487             | \$1.23877 | \$1.71505    | \$1.88836 |
| December  | \$1.05329          | \$0.82487             | \$1.23877 | \$1.87816    | \$1.98294 |

<sup>10</sup> The SoCalGas procurement and transmission charges were obtained from the following site:  
<https://www.socalgas.com/for-your-business/energy-market-services/gas-prices>

|  |                |  |
|--|----------------|--|
| Schedule No. GM  |                | Sheet 2                                |
| <u>MULTI-FAMILY SERVICE</u>  |                |  |
| (Includes GM-E, GM-C, GM-EC, GM-CC, GT-ME, GT-MC and all GMB Rates)  |                |  |
| (Continued)  |                |  |
| <u>APPLICABILITY</u> (Continued)   |                |  |
| Multi-family Accommodations built prior to December 15, 1981 and currently served under this schedule may also be eligible for service under Schedule No. GS. If an eligible Multi-family Accommodation served under this schedule converts to an applicable submetered tariff, the tenant rental charges shall be revised for the duration of the lease to reflect removal of the energy related charges. |                |  |
| Eligibility for service hereunder is subject to verification by the Utility.   |                |  |
| <u>TERRITORY</u>   |                |  |
| Applicable throughout the service territory.   |                |  |
| <u>RATES</u>   |                |  |
|  | <u>GM/GT-M</u> | <u>GMB/GT-MB</u>                       |
| Customer Charge, per meter, per day: .....   | 16.438¢        | \$19.792                               |
| For "Space Heating Only" customers, a daily Customer Charge applies during the winter period from November 1 through April 30 <sup>1/2</sup> : .....   |                |  |
|  | 33.149¢        |  |
| <u>GM</u>  |                |  |
|  | <u>GM-E</u>    | <u>GM-EC<sup>3/</sup></u> <u>GT-ME</u> |
| Baseline Rate, per therm (baseline usage defined per Special Conditions 3 and 4):  |                |  |
| Procurement Charge: <sup>2/</sup> .....  | 110.870¢       | 110.870¢ N/A                           |
| Transmission Charge: .....   | 90.256¢        | 90.256¢ 90.256¢                        |
| Total Baseline Charge (all usage): .....   | 201.126¢       | 201.126¢ 90.256¢                       |
| Non-Baseline Rate, per therm (usage in excess of baseline usage):  |                |  |
| Procurement Charge: <sup>2/</sup> .....  | 110.870¢       | 110.870¢ N/A                           |
| Transmission Charge: .....   | 135.367¢       | 135.367¢ 135.367¢                      |
| Total Non Baseline Charge (all usage): .....   | 246.237¢       | 246.237¢ 135.367¢                      |

3. Baseline Usage: The following usage is to be billed at the Baseline rate for Multi-family Accommodation units. Usage in excess of applicable Baseline allowances will be billed at the Non-Baseline rate.

| Per Residence                          | Daily Therm Allowance<br>for Climate Zones* |          |          |
|--|---|----------|----------|
|  | <u>1</u>                                    | <u>2</u> | <u>3</u> |
| Summer (May 1- Oct.31)                 | 0.424                                       | 0.424    | 0.424    |
| Winter On-Peak (Dec., Jan., and Feb.)  | 1.600                                       | 1.867    | 2.600    |
| Winter Off-Peak (Nov., Mar., and Apr.) | 0.874                                       | 0.923    | 1.714    |

## 7.2.4 San Diego Gas & Electric

Following are the SDG&E electricity and natural gas tariffs applied in this study. **Error! Reference source not found.** describes the baseline territories that were assumed for each climate zone. A net surplus compensation rate of \$0.04174 / kWh was applied to any net annual electricity generation based on a one-year average of the rates between January 2022 and December 2022.

**Table 29. 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 **Error! Reference source not found.** These rates are based on applying a normalization curve to the December 2022 tariff based on eleven years of historical gas data. See the beginning of Section **Error! Reference source not found.** **Error! Reference source not found.** for further details. CARE rates reflect the 20 percent discount per the G-CARE tariff.

**Table 30. SDG&E Monthly Gas Rate (\$/therm)**

| Month     | Total Charge |           |
|-----------|--------------|-----------|
|           | Baseline     | Excess    |
| January   | \$2.33762    | \$2.34748 |
| February  | \$2.26751    | \$2.28440 |
| March     | \$2.25119    | \$2.27016 |
| April     | \$2.20192    | \$2.22744 |
| May       | \$2.24252    | \$2.26403 |
| June      | \$2.31819    | \$2.33060 |
| July      | \$2.32406    | \$2.33630 |
| August    | \$2.37527    | \$2.38090 |
| September | \$2.33542    | \$2.34971 |
| October   | \$2.30366    | \$2.32151 |
| November  | \$2.31722    | \$2.33381 |
| December  | \$2.45653    | \$2.73517 |

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

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

| SCHEDULE GM  |           |           |                       | Sheet 2 |
|--|-----------|-----------|-----------------------|---------|
| MULTI-FAMILY NATURAL GAS SERVICE<br>(Includes Rates for GM, GM-C and GTC/GTCA)   |           |           |                       |         |
| <b>RATES</b>   |           |           |                       |         |
| Baseline Rate, per therm (baseline usage defined in Special Condition 4)   | GM        | GM-C      | GTC/GTCA <sup>1</sup> |         |
| Procurement Charge <sup>2</sup> .....  | \$1.05454 | \$1.42421 | I N/A                 |         |
| Transmission Charge.....   | \$1.40199 | \$1.40199 | \$1.40201             |         |
| Total Baseline Charge.....   | \$2.45653 | \$2.82620 | I \$1.40201           |         |
| <u>Non-Baseline Rate (usage in excess of baseline usage)</u>   |           |           |                       |         |
| Procurement Charge <sup>2</sup> .....  | \$1.05454 | \$1.42421 | I N/A                 |         |
| Transmission Charge.....   | \$1.68063 | \$1.68063 | \$1.68065             |         |
| Total Non-Baseline Charge.....   | \$2.73517 | \$3.10484 | I \$1.68065           |         |
| <u>Minimum Bill, per day<sup>3</sup></u>   |           |           |                       |         |
| Non-CARE customers.....  | \$0.13151 | \$0.13151 | \$0.13151             |         |
| CARE customers.....  | \$0.10521 | \$0.10521 | \$0.10521             |         |
| <u>Franchise Fee Differential:</u>   |           |           |                       |         |
| A Franchise Fee Differential of 1.03% 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.   |           |           |                       |         |
| <u>Additional Charges</u>  |           |           |                       |         |
| Rates may be adjusted to reflect any applicable taxes, franchise fees or other fees, regulatory surcharges, and interstate or intrastate pipeline charges that may occur.  |           |           |                       |         |
| <b>SPECIAL CONDITIONS</b>  |           |           |                       |         |
| 1. <u>Definitions.</u> The definitions of principal terms used in this schedule are found either herein or in Rule 1, Definitions.   |           |           |                       |         |
| 2. <u>Number of Therms.</u> The number of therms to be billed shall be determined in accordance with Rule 2. The daily therm allowance in the Baseline Usage, shown in Special Condition 4, shall be multiplied by the number of qualified residential units. It is the responsibility of the customer to advise the Utility within 15 days following any change in the submetering arrangements or the number of dwelling units or Mobilehome Park spaces provided gas service. The number of qualifying units is subject to verification by the Utility. |           |           |                       |         |
| 3. <u>Exclusions.</u> Gas service for non-domestic enterprises such as rooming houses, boarding houses, dormitories, rest homes, military barracks, transient trailer parks, stores, restaurants, service stations, and other similar establishments will be separately metered and billed under the applicable schedules.   |           |           |                       |         |
| <sup>1</sup> The rates for core transportation-only customers, with the exception of customers taking service under Schedule GT-NGV, include any FERC Settlement Proceeds Memorandum Account (FSPMA) credit adjustments.   |           |           |                       |         |
| <sup>2</sup> This charge is applicable to Utility Procurement Customers and includes the GPC and GPC-A Procurement Charges shown in Schedule GPC which are subject to change monthly as set forth in Special Condition 7.  |           |           |                       |         |
| <sup>3</sup> Effective starting May 1, 2020, the minimum bill is calculated as the minimum bill charge of \$0.13151 per day times the number of days in the billing cycle (approximately \$4 per month) with a 20% discount applied for CARE customer resulting in a minimum bill charge of \$0.10521 per day (approximately \$3.20 per month).  |           |           |                       |         |
| (Continued)  |           |           |                       |         |
| 2H7  | Issued by | Submitted | Dec 9, 2022           |         |
| Advice Ltr. No. 3145-G   |           | Effective | Dec 10, 2022          |         |



San Diego Gas & Electric Company  
San Diego, California

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

Canceling Revised Cal. P.U.C. Sheet No. 35747-E

## SCHEDULE TOU-DR1 RESIDENTIAL TIME-OF-USE

Sheet 2

### RATES

#### Total Rates:

| Description – TOU DR1                                    | UDC Total Rate |   | DWR BC + WF-NBC |   | EECC Rate + DWR Credit |   | Total Rate |   |
|--|----------------|---|-----------------|---|------------------------|---|------------|---|
| <b>Summer:</b>   |                |   |                 |   |                        |   |            |   |
| On-Peak  | 0.26467        | I | 0.00309         | R | 0.42232                | R | 0.69008    | R |
| Off-Peak   | 0.26467        | I | 0.00309         | R | 0.19003                | R | 0.45779    | I |
| Super Off-Peak   | 0.26467        | I | 0.00309         | R | 0.06802                | R | 0.33578    | I |
| <b>Winter:</b>   |                |   |                 |   |                        |   |            |   |
| On-Peak  | 0.39848        | I | 0.00309         | R | 0.14268                | R | 0.54425    | R |
| Off-Peak   | 0.39848        | I | 0.00309         | R | 0.08004                | R | 0.48161    | I |
| Super Off-Peak   | 0.39848        | I | 0.00309         | R | 0.06187                | R | 0.46344    | I |
| Summer Baseline Adjustment Credit up to 130% of Baseline | (0.10182)      | R |                 |   |                        |   | (0.10182)  | R |
| Winter Baseline Adjustment Credit up to 130% of Baseline | (0.10182)      | R |                 |   |                        |   | (0.10182)  | R |
| Minimum Bill (\$/day)                                    | 0.350          |   |                 |   |                        |   | 0.350      |   |

#### 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 0.00652 + DWR-BC Bond Charge is (0.00343).

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(Continued)

2C10

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Issued by

**Dan Skopec**

Vice President  
Regulatory Affairs

Submitted

May 16, 2022

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Jun 1, 2022

Resolution No.

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.;<br>9:00 p.m. - midnight | 6:00 a.m. – 4:00 p.m.<br>Excluding 10:00 a.m. – 2:00 p.m. in March and April;<br>9:00 p.m. - midnight |
| Super Off-Peak                     | Midnight – 6:00 a.m.                           | Midnight – 6:00 a.m.<br>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.;<br>9:00 p.m. - midnight | 2:00 p.m. – 4:00 p.m.;<br>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 |
| <b>Basic Allowance</b>        |  |        |          |        |
| 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   |
| <b>All Electric**</b>         |  |        |          |        |
| 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.

- (1) Total Rates consist of UDC, Schedule DWR-BC (Department of Water Resources Bond Charge), and Schedule EECC (Electric Energy Commodity Cost) rates, with the EECC rates reflecting a DWR Credit of \$0.00000 that customers receive on their monthly bills.
- (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 charges do not apply to CARE or Medical Baseline customers.
- (4) Total Effective CARE Rate is presented for illustrative purposes only, and reflects the average effective CARE discount CARE customers receive which consists of (a) exemptions from paying the CARE Surcharge, DWR-BC, California Solar Initiative (CSI) and Vehicle-Grid Integration (VGI) Costs; (b) a 50% minimum bill relative to Non-CARE; and (c) a separate line-item bill discount for all qualified residential CARE customers.
- (5) Current DWR-BC as presented is now used for collecting the California Wildfire Fund Charge effective Oct 1, 2020 (See Schedule WF – NBC). DWR BC will be renamed at implementation of SDG&E's new customer information system.



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 |
|---------------------------|------------|------------|------------|------------|--------------|-----------------|
| <b>Effective Discount</b> | <b>40%</b> | <b>39%</b> | <b>38%</b> | <b>38%</b> | <b>36% R</b> | <b>35%</b>      |

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

(Continued)

1C5

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Issued by  
**Dan Skopec**  
Vice President

Submitted Dec 30, 2021  
Effective Jan 1, 2022

T

## 7.2.5 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 **Error! Reference source not found.** These rates are based on applying a normalization curve to the December 2022 tariff based on three years of historical gas data. See the beginning of Section **Error! Reference source not found. Error! Reference source not found.** for further details. The monthly service charge applied was \$106.90 per month per the December 2022 G-2 tariff.

**Table 31. CPAU Monthly Gas Rate (\$/therm)**

| Month     | G2<br>Volumetric<br>Totals |
|-----------|----------------------------|
| January   | \$1.80964                  |
| February  | \$1.67009                  |
| March     | \$1.68480                  |
| April     | \$1.68698                  |
| May       | \$1.78478                  |
| June      | \$1.88288                  |
| July      | \$1.88355                  |
| August    | \$2.06943                  |
| September | \$2.06798                  |
| October   | \$2.08553                  |
| November  | \$2.09681                  |
| December  | \$2.45700                  |

### 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:

| <u>Per kilowatt-hour (kWh)</u>        | <u>Commodity</u> | <u>Distribution</u> | <u>Public Benefits</u> | <u>Total</u> |
|---------------------------------------|------------------|---------------------|------------------------|--------------|
| Tier 1 usage                          | \$0.08547        | \$0.05429           | \$0.00469              | \$0.14445    |
| Tier 2 usage<br>Any usage over Tier 1 | 0.11858          | 0.08008             | 0.00469                | 0.20335      |
| <u>Minimum Bill (\$/day)</u>          |                  |                     |                        | 0.3447       |

## RESIDENTIAL MASTER-METERED AND SMALL NON-RESIDENTIAL ELECTRIC SERVICE

### UTILITY RATE SCHEDULE E-2

**A. APPLICABILITY:**

This Rate Schedule applies to the following Customers receiving Electric Service from the City of Palo Alto Utilities:

1. Small non-residential Customers receiving Non-Demand Metered Electric Service; and
2. Customers with Accounts at Master-Metered multi-family facilities.

**B. TERRITORY:**

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

**C. UNBUNDLED RATES:**

| <u>Per kilowatt-hour (kWh)</u> | <u>Commodity</u> | <u>Distribution</u> | <u>Public Benefits</u> | <u>Total</u> |
|--------------------------------|------------------|---------------------|------------------------|--------------|
| Summer Period                  | \$0.12151        | \$0.09276           | \$0.00469              | \$0.21896    |
| Winter Period                  | 0.08715          | 0.06171             | 0.00469                | 0.15355      |
| <u>Minimum Bill (\$/day)</u>   |                  |                     |                        | 0.8777       |

## EXPORT ELECTRICITY COMPENSATION

### UTILITY RATE SCHEDULE E-EEC-1

**A. APPLICABILITY:**

This Rate Schedule applies in conjunction with the otherwise applicable Rate Schedules for each Customer class. This Rate Schedule may not apply in conjunction with any time-of-use Rate Schedule. This Rate Schedule applies to Customer-Generators as defined in Rule and Regulation 2 who are either not eligible for Net Energy Metering or who are eligible for Net Energy metering but elect to take Service under this Rate Schedule.

**B. TERRITORY:**

Applies to locations within the service area of the City of Palo Alto.

**C. RATE:**

The following buyback rate shall apply to all electricity exported to the grid.

|                                      | <u>Per kWh</u> |
|--------------------------------------|----------------|
| Export electricity compensation rate | \$0.1045       |

## 7.2.6 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<br>October 1, 2021 | Effective as of<br>March 1, 2022 | Effective as of<br>January 1, 2023 |
|---|------------------------------------|----------------------------------|------------------------------------|
| <b>Time-of-Day (5-8 p.m.) Rate (RT02)</b>                     |                                    |                                  |                                    |
| <b>Non-Summer Season (October - May)</b>                      |                                    |                                  |                                    |
| System Infrastructure Fixed Charge <i>per month per meter</i> | \$22.70                            | \$23.05                          | \$23.50                            |
| Electricity Usage Charge                                      |                                    |                                  |                                    |
| Peak <i>\$/kWh</i>  | \$0.1494                           | \$0.1516                         | \$0.1547                           |
| Off-Peak <i>\$/kWh</i>  | \$0.1082                           | \$0.1098                         | \$0.1120                           |
| <b>Summer Season (June - September)</b>                       |                                    |                                  |                                    |
| System Infrastructure Fixed Charge <i>per month per meter</i> | n/a                                | \$23.05                          | \$23.50                            |
| Electricity Usage Charge                                      |                                    |                                  |                                    |
| Peak <i>\$/kWh</i>  | n/a                                | \$0.3215                         | \$0.3279                           |
| Mid-Peak <i>\$/kWh</i>  | n/a                                | \$0.1827                         | \$0.1864                           |
| Off-Peak <i>\$/kWh</i>  | n/a                                | \$0.1323                         | \$0.1350                           |

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

- 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.
- 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.
- 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.

|  |                 |  |
|--|-----------------|--|
| <b>Summer<br/>(Jun 1 - Sept 30)</b>    | <b>Peak</b>     | Weekdays between 5:00 p.m. and 8:00 p.m.                         |
|  | <b>Mid-Peak</b> | Weekdays between noon and midnight except during the Peak hours. |
|  | <b>Off-Peak</b> | All other hours, including weekends and holidays <sup>1</sup> .  |
| <b>Non-Summer<br/>(Oct 1 - May 31)</b> | <b>Peak</b>     | Weekdays between 5:00 p.m. and 8:00 p.m.                         |
|  | <b>Off-Peak</b> | All other hours, including weekends and holidays <sup>1</sup> .  |

<sup>1</sup> See Section V. Conditions of Service

### C. Master-Metered Multifamily Accommodation and Mobile Home Park Billing (Rate Category RSMM) Closed

|   | Effective as of<br>October 1, 2021 | Effective as of<br>March 1, 2022 | Effective as of<br>January 1, 2023 |
|---|------------------------------------|----------------------------------|------------------------------------|
| <b>Master Metered Multifamily and Mobile Home Park Billing (Closed)</b> |                                    |                                  |                                    |
| <b>Non-Summer Season (October - May)</b>                                |                                    |                                  |                                    |
| <b>System Infrastructure Fixed Charge</b> <i>per month per meter</i>    | \$22.70                            | \$23.05                          | \$23.50                            |
| <b>Electricity Usage Charge</b>   |                                    |                                  |                                    |
| All kWh usage per month <i>\$/kWh</i>                                   | \$0.1279                           | \$0.1298                         | \$0.1324                           |
| <b>Summer Season (June - September)</b>                                 |                                    |                                  |                                    |
| <b>System Infrastructure Fixed Charge</b> <i>per month per meter</i>    | n/a                                | \$23.05                          | \$23.50                            |
| <b>Electricity Usage Charge</b>   |                                    |                                  |                                    |
| All kWh usage per month <i>\$/kWh</i>                                   | n/a                                | \$0.1486                         | \$0.1516                           |

## 7.2.7 Fuel Escalation Assumptions

The average annual escalation rates in **Error! Reference source not found.** 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 32: Real Utility Rate Escalation Rate Assumptions**

|      | Statewide Natural Gas Residential Average Rate (%/year, real) | Electric Residential Average Rate (%/year, real) |      |       |
|------|---|--|------|-------|
|      |   | PG&E   | SCE  | SDG&E |
| 2023 | 4.6%  | 1.8%   | 1.6% | 2.8%  |
| 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%  |

## 7.3 Cost Details

Table 33 presents additional detail on the first cost assumptions for the central water heating systems. For the 5-story prototype costs are provided both for a CO<sub>2</sub> refrigerant Sanden-based and R-134a refrigerant Colmac-based heat pump water heater designs. The results presented in the main body of this report are based on the Sanden design. A sensitivity analysis was also conducted for a Colmac design (see Appendix 7.5 Central Heat Pump Water Heater Comparison) and the cost comparison is presented here. All costs are based on data from the 2022 Multifamily All-Electric CASE Report (Statewide CASE Team, 2020c).

**Table 33. Heat Pump Water Heater First Costs per Building (Present Value (2023\$))**

| Item                    | 3-Story (36-units)   |                        |                  | 5-Story (88-units)   |                        |                    |                    |
|-------------------------|----------------------|------------------------|------------------|----------------------|------------------------|--------------------|--------------------|
|                         | Gas Boiler (CZs 1-9) | Gas Boiler (CZs 10-16) | Heat Pump        | Gas Boiler (CZs 1-9) | Gas Boiler (CZs 10-16) | Heat Pump (Sanden) | Heat Pump (Colmac) |
| Water Heating Equipment | \$87,602             | \$87,602               | \$140,907        | \$135,146            | \$135,146              | \$244,742          | \$319,485          |
| Solar Thermal Collector | \$39,800             | \$46,888               | n/a              | \$74,740             | \$91,776               | n/a                | n/a                |
| Gas Piping              | \$8,890              | \$8,890                | n/a              | \$9,065              | \$9,065                | n/a                | n/a                |
| Electrical Circuits     | n/a                  | n/a                    | \$25,000         | n/a                  | n/a                    | \$25,000           | \$25,000           |
| Overhead & Markup       | \$37,480             | \$39,430               | \$45,624         | \$60,212             | \$64,896               | \$74,179           | \$94,733           |
| <b>Total</b>            | <b>\$173,772</b>     | <b>\$182,810</b>       | <b>\$211,531</b> | <b>\$279,163</b>     | <b>\$300,883</b>       | <b>\$343,920</b>   | <b>\$439,218</b>   |

Table 34 presents additional detail on the first cost assumptions for the space heating systems.

**Table 34. Heat Pump Space Heater First Costs per Dwelling Unit (Present Value (2023\$))**

| Item                    | 3-Story            |                  | 5-Story            |                  | Source & Notes  |
|-------------------------|--------------------|------------------|--------------------|------------------|---|
|                         | Furnace + Split AC | Heat Pump        | Furnace + Split HP | Heat Pump        |   |
| Dwelling Unit HVAC      | \$5,651            | \$5,460          | \$6,109            | \$5,460          | Gas system costs based on 2022 Multifamily All-Electric CASE Report. Heat pump costs based on online equipment research indicating a 2-ton HP is \$191 less than a furnace/AC of the same size. |
| Refrigerant Piping      | \$563              | \$563            | \$423              | \$423            | 2022 Multifamily All-Electric CASE Report.  |
| Gas Piping              | \$92               | \$0              | \$227              | \$0              |   |
| Electrical Circuits     | \$0                | \$150            | \$0                | \$150            |   |
| Labor                   | \$9,904            | \$6,985          | \$9,904            | \$6,985          | Based on the 2022 Multifamily All-Electric CASE Report with adjustments to align with updated equipment costs.  |
| Overhead & Markup       | \$4,457            | \$3,618          | \$4,582            | \$3,579          | Based on a 27% markup   |
| <b>Total</b>            | <b>\$20,667</b>    | <b>\$16,776</b>  | <b>\$21,245</b>    | <b>\$16,597</b>  |   |
| <b>Incremental Cost</b> |                    | <b>(\$3,891)</b> |                    | <b>(\$4,647)</b> |   |

## 7.4 PG&E Gas Infrastructure Cost Memo



Janice Berman  
Director – Grid Edge  
Pacific Gas and Electric Company  
Mail Code B9F  
P.O. Box 770000  
San Francisco, CA 94177-00001

December 5, 2019

Energy Commission Staff:

On March 2, 2018, PG&E provided gas extension cost estimates for residential existing and new subdivisions (see attached memo). We have recently updated our estimates and are therefore providing an updated memo.

In addition to mainline and service extension costs, we are also providing estimates of the cost of gas meters for different building types including both residential and commercial customers. These estimates are based on PG&E historical jobs.

Developing gas extension cost estimates is complex and the actual costs are project dependent. Costs vary widely with location, terrain, distance to the nearest main, joint trenching, materials, number of dwellings per development, and several other site and job-specific conditions. For these reasons, it is not practical to come up with estimates that represent every case. Instead we are including estimates based on historical averages taken from projects within PG&E's territory. It is not recommended to compare specific project costs to these estimates as any number of factors could lead to higher or lower costs than these averages are representing.

We are also including estimates for in-house gas infrastructure costs and specific plan review costs. These estimates are from external sources, and are not based on PG&E data, but have been provided for the sake of completeness and for use in energy efficiency analysis.

To further anchor the estimates, several assumptions have been made:

1. It is assumed that during new construction, gas infrastructure will likely be joint trenched with electric infrastructure. As a result, the incremental cost of trenching associated with the gas infrastructure alone is minimal. Therefore, all mainline cost estimates exclude trench costs. Service extension cost estimates include both estimates with and without trench costs. In the case where new construction would require overhead electric and underground gas infrastructure, the estimates with trench costs included for service extensions should be utilized.
2. It is assumed that new construction in an existing subdivision would not generally require a mainline extension. In cases where a mainline extension would be required to an existing subdivision, the costs are highly dependent on the location, terrain, and distance to the nearest main.



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3. These estimates are for total costs. The cost estimates have not been reduced to account for the portion of the costs paid by all customers due to application of Rule 15<sup>1</sup> and Rule 16<sup>2</sup> allowances. Hence, costs to the specific customer may be lower than the estimates below, as the specific customer benefits from the Rule 15 and Rule 16 allowances.

Table 1: PG&E Gas Infrastructure Cost Estimates

|   | Existing<br>Subdivision/Development   | New Greenfield<br>Subdivision/Development  |
|---|---|--|
| Mainline Extension  | N/A <sup>3</sup>  | <u>Single-Family</u><br>\$17/ft <sup>4</sup><br><br><u>Multi-Family</u><br>\$11/ft <sup>4</sup>  |
| Service Extension<br>(Typically 1" pipe<br>from mainline to<br>the meter) | \$6750 per service/building <sup>4</sup><br>(excludes trench costs)<br><br>\$9200 per service/building <sup>4</sup><br>(includes trench costs)  | \$1300 per service/building <sup>4</sup><br>(includes mainline extension costs<br>within the subdivision; excludes<br>trench costs)<br><br>\$1850 per service/building <sup>4</sup><br>(includes mainline extension costs<br>within the subdivision; includes<br>trench costs) |
| Meter   | <u>Residential Single Family</u><br>\$300 per meter <sup>5</sup><br><br><u>Residential Multi-Family</u><br>\$300 per meter + \$300 per meter<br>manifold outlet <sup>5</sup><br><br><u>Small/Medium Commercial</u><br>\$3600 per meter <sup>6</sup> | <u>Residential Single Family</u><br>\$300 per meter <sup>5</sup><br><br><u>Residential Multi-Family</u><br>\$300 per meter + \$300 per meter<br>manifold outlet <sup>5</sup><br><br><u>Small/Medium Commercial</u><br>\$3600 per meter <sup>6</sup>                            |

<sup>1</sup> [https://www.pge.com/tariffs/tm2/pdf/ELEC\\_RULES\\_15.pdf](https://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_15.pdf)

<sup>2</sup> [https://www.pge.com/tariffs/tm2/pdf/ELEC\\_RULES\\_16.pdf](https://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_16.pdf)

<sup>3</sup> It is assumed that new construction in an existing subdivision would not require a main extension.

<sup>4</sup> Estimates based on PG&E jobs from Jan 2016 - Dec 2017 from PG&E's Service Planning team.

<sup>5</sup> Estimates from PG&E's Dedicated Estimating Team. For Multi-Family units, the costs of \$300 per meter and \$300 per meter manifold outlet should be combined for a total of \$600 per meter.

<sup>6</sup> PG&E Marginal Customer Access Cost Estimates presented in the 2018 Gas Cost Allocation Proceedings (GCAP), A.17-09-006, Exhibit PG&E-2, Appendix A, Section A, Table A-1. The Average Connection Cost per Customer values were included in the MCAC workpaper that accompanied the GCAP testimony



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|  |  |  |
|--|--|--|
|  | <u>Large Commercial</u><br>\$32,000 per meter <sup>6</sup> | <u>Large Commercial</u><br>\$32,000 per meter <sup>6</sup> |
|--|--|--|

Note: Service extension cost estimates for New Greenfield Subdivisions include mainline extension costs as well. Therefore, mainline cost estimates can be ignored for the purpose of estimating total project costs.

Table 2: Gas Infrastructure Cost Estimates from Other Sources

|  | Existing Subdivision/Development                         | New Greenfield Subdivision/Development                   |
|--|--|--|
| In-House Infrastructure                                      | <u>Single-Family</u><br>\$800 <sup>7</sup>               | <u>Single-Family</u><br>\$800 <sup>7</sup>               |
|  | <u>Multi-Family</u><br>\$600 per unit <sup>7</sup>       | <u>Multi-Family</u><br>\$600 per unit <sup>7</sup>       |
|  | <u>Medium Office</u><br>\$600-4500 <sup>7,8</sup>        | <u>Medium Office</u><br>\$600-4500 <sup>7,8</sup>        |
|  | <u>Medium Retail</u><br>\$10,000 <sup>8</sup>            | <u>Medium Retail</u><br>\$10,000 <sup>8</sup>            |
| Plan Review<br>(Will vary by city and often not a fixed fee) | <u>Residential</u><br>Palo Alto - \$850 <sup>9</sup>     | <u>Residential</u><br>Palo Alto - \$850 <sup>9</sup>     |
|  | <u>Nonresidential</u><br>Palo Alto - \$2316 <sup>9</sup> | <u>Nonresidential</u><br>Palo Alto - \$2316 <sup>9</sup> |

Please let us know if there are any follow-up questions or clarifications.

Best regards,

<sup>7</sup> Frontier Energy, Inc., Misti Bruceri & Associates, LLC. 2019. "2019 Cost-effectiveness Study: Low Rise Residential New Construction." Available at: <https://localenergycodes.com/content/performance-ordinances>

<sup>8</sup> TRC, EnergySoft. 2019. "2019 Nonresidential New Construction Reach Code Cost Effectiveness Study." Available at: <https://localenergycodes.com/content/performance-ordinances>

<sup>9</sup> TRC. 2018. "City of Palo Alto 2019 Title 24 Energy Reach Code Cost Effectiveness Analysis Draft." Available at: <http://cityofpaloalto.org/civicax/filebank/documents/66742>

7.5 Central Heat Pump Water Heater Comparison

Table 35 presents energy and cost-effectiveness results for a R-134a refrigerant based system design using a Colmac central heat pump water heater in the 5-story prototype. This was only found to be cost-effective based on at least one of the two metrics in Climate Zones 1, 4 in CPAU territory, and 16.

Table 35. 5-Story Cost-Effectiveness: All-Electric Prescriptive Code with R-134a Heat Pump Water Heater

| Climate Zone | Electric /Gas Utility | Efficiency TDV Comp Margin | Source Comp Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |           | TDV       |           |
|--------------|-----------------------|----------------------------|--------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|-----------|-----------|-----------|
|              |                       |                            |                    |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV       | B/C Ratio | NPV       |
| CZ01         | PGE                   | 6%                         | 6%                 | -1,496                    | 147                         | (\$155)              | (\$1,240)          | (\$3,556)        | (\$4,223)          | 3.4       | \$2,984   | >1        | \$5,870   |
| CZ02         | PGE                   | 4%                         | 2%                 | -1,197                    | 120                         | (\$145)              | (\$1,513)          | \$1,691          | \$2,749            | 0.0       | (\$4,262) | 0.5       | (\$1,287) |
| CZ03         | PGE                   | 6%                         | 3%                 | -1,166                    | 120                         | (\$138)              | (\$1,360)          | \$1,691          | \$2,749            | 0.0       | (\$4,109) | 0.8       | (\$523)   |
| CZ04         | PGE                   | 4%                         | 2%                 | -1,116                    | 113                         | (\$76)               | (\$49)             | \$1,691          | \$2,749            | 0.0       | (\$2,798) | 0.7       | (\$949)   |
| CZ04         | CPAU                  | 4%                         | 2%                 | -1,116                    | 113                         | \$185                | \$7,144            | \$1,718          | \$2,776            | 2.6       | \$4,368   | 0.6       | (\$976)   |
| CZ05         | PGE                   | 5%                         | 2%                 | -1,161                    | 117                         | (\$137)              | (\$1,391)          | \$1,691          | \$2,749            | 0.0       | (\$4,140) | 0.5       | (\$1,412) |
| CZ05         | PGE/SCG               | 5%                         | 2%                 | -1,161                    | 117                         | (\$189)              | (\$3,016)          | \$1,691          | \$2,749            | 0.0       | (\$5,765) | 0.5       | (\$1,412) |
| CZ06         | SCE/SCG               | 4%                         | 1%                 | -1,000                    | 104                         | (\$92)               | (\$879)            | \$1,691          | \$2,749            | 0.0       | (\$3,628) | 0.6       | (\$1,013) |
| CZ07         | SDGE                  | 5%                         | 2%                 | -996                      | 106                         | (\$183)              | (\$3,216)          | \$1,691          | \$2,749            | 0.0       | (\$5,965) | 0.7       | (\$936)   |
| CZ08         | SCE/SCG               | 3%                         | 1%                 | -948                      | 100                         | (\$156)              | (\$2,413)          | \$1,691          | \$2,749            | 0.0       | (\$5,162) | 0.7       | (\$695)   |
| CZ09         | SCE                   | 3%                         | 0%                 | -966                      | 100                         | (\$132)              | (\$1,863)          | \$1,691          | \$2,749            | 0.0       | (\$4,612) | 0.7       | (\$738)   |
| CZ10         | SCE/SCG               | 3%                         | 1%                 | -962                      | 84                          | (\$188)              | (\$3,375)          | \$1,444          | \$2,395            | 0.0       | (\$5,770) | 0.3       | (\$1,596) |
| CZ10         | SDGE                  | 3%                         | 1%                 | -962                      | 84                          | (\$239)              | (\$4,959)          | \$1,444          | \$2,395            | 0.0       | (\$7,354) | 0.3       | (\$1,596) |
| CZ11         | PGE                   | 4%                         | 3%                 | -1,029                    | 92                          | (\$165)              | (\$2,487)          | \$1,444          | \$2,395            | 0.0       | (\$4,882) | 0.4       | (\$1,367) |
| CZ12         | PGE                   | 4%                         | 3%                 | -1,081                    | 96                          | (\$172)              | (\$2,591)          | \$1,444          | \$2,395            | 0.0       | (\$4,986) | 0.3       | (\$1,667) |
| CZ12         | SMUD/PGE              | 4%                         | 3%                 | -1,081                    | 96                          | \$26                 | \$1,988            | \$1,444          | \$2,395            | 0.8       | (\$407)   | 0.3       | (\$1,667) |
| CZ13         | PGE                   | 3%                         | 2%                 | -976                      | 88                          | (\$156)              | (\$2,361)          | \$1,444          | \$2,395            | 0.0       | (\$4,756) | 0.4       | (\$1,452) |
| CZ14         | SCE/SCG               | 2%                         | -1%                | -1,045                    | 84                          | (\$210)              | (\$3,880)          | \$1,444          | \$2,395            | 0.0       | (\$6,275) | 0.1       | (\$2,056) |
| CZ14         | SDGE                  | 2%                         | -1%                | -1,045                    | 84                          | (\$270)              | (\$5,725)          | \$1,444          | \$2,395            | 0.0       | (\$8,120) | 0.1       | (\$2,056) |
| CZ15         | SCE/SCG               | 2%                         | -1%                | -718                      | 65                          | (\$146)              | (\$2,713)          | \$1,444          | \$2,395            | 0.0       | (\$5,108) | 0.3       | (\$1,564) |
| CZ16         | PG&E                  | -5%                        | 6%                 | -1,913                    | 142                         | (\$276)              | (\$4,142)          | (\$3,803)        | (\$4,577)          | 1.1       | \$435     | 1.2       | \$746     |

## 7.6 Summary of Measures by Package

Table 36 provides the details of the measures in each of the efficiency package by climate zone. The measures are the same for the 3-story and 5-story prototypes. Table 37 presents the PV capacities per dwelling unit in the upgrade packages. In Climate Zone 6 for the mixed fuel case in the 5-story prototype there is no upgrade to the PV system capacity as the prescriptive PV system already offset all of the estimated electricity use.

**Table 36. Mixed Fuel Efficiency Package Measures**

| Climate Zone | 0.70 Roof Solar Reflectance | 0.24 U-Factor Windows | 0.35 W/cfm | Verified Low Leakage Ducts in Conditioned Space |
|--------------|-----------------------------|-----------------------|------------|---|
| 1            |                             |                       | X          | X   |
| 2            |                             |                       |            | X   |
| 3            |                             |                       |            | X   |
| 4            |                             |                       |            | X   |
| 5            |                             |                       |            | X   |
| 6            |                             |                       |            | X   |
| 7            |                             |                       |            | X   |
| 8            |                             |                       |            | X   |
| 9            | X                           |                       |            | X   |
| 10           | X                           |                       | X          | X   |
| 11           | X                           |                       | X          | X   |
| 12           | X                           |                       | X          | X   |
| 13           | X                           |                       | X          | X   |
| 14           | X                           |                       | X          | X   |
| 15           | X                           |                       | X          | X   |
| 16           |                             | X                     | X          | X   |

**Table 37. Upgrade Package PV Capacities (kW-DC)**

| Climate Zone | All-Electric + PV |         | Mixed Fuel + PV |         |
|--------------|-------------------|---------|-----------------|---------|
|              | 3-Story           | 5-Story | 3-Story         | 5-Story |
| <b>CZ01</b>  | 4.41              | 4.35    | 3.69            | 3.43    |
| <b>CZ02</b>  | 3.56              | 3.58    | 3.02            | 2.98    |
| <b>CZ03</b>  | 3.31              | 3.29    | 2.80            | 2.72    |
| <b>CZ04</b>  | 3.21              | 3.27    | 2.73            | 2.75    |
| <b>CZ05</b>  | 3.04              | 3.08    | 2.57            | 2.55    |
| <b>CZ06</b>  | 2.91              | 3.04    | 2.49            | 2.68    |
| <b>CZ07</b>  | 3.09              | 3.21    | 2.64            | 2.74    |
| <b>CZ08</b>  | 3.18              | 3.30    | 2.76            | 2.86    |
| <b>CZ09</b>  | 3.04              | 3.16    | 2.63            | 2.73    |
| <b>CZ10</b>  | 3.20              | 3.30    | 2.79            | 2.86    |
| <b>CZ11</b>  | 3.90              | 3.95    | 3.42            | 3.43    |
| <b>CZ12</b>  | 3.53              | 3.60    | 3.05            | 3.08    |
| <b>CZ13</b>  | 3.77              | 3.84    | 3.32            | 3.36    |
| <b>CZ14</b>  | 3.20              | 3.23    | 2.79            | 2.79    |
| <b>CZ15</b>  | 3.93              | 3.94    | 3.58            | 3.58    |
| <b>CZ16</b>  | 3.79              | 3.76    | 2.60            | 2.90    |

## 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](https://LocalEnergyCodes.com) to access our resources and sign up for newsletters



Contact [info@localenergycodes.com](mailto:info@localenergycodes.com) for no-charge assistance from expert Reach Code advisors



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# 2022 Cost-Effectiveness Study: Single Family New Construction



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### 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

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

CFI – California Flexible Installation

CFM – Cubic Feet per Minute

CO<sub>2</sub> – Carbon Dioxide

CPAU – City of Palo Alto Utilities

CPUC – California Public Utilities Commission

CZ – California Climate Zone

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

HPWH – Heat Pump Water Heater

HSPF – Heating Seasonal Performance Factor

IECC – International Energy Conservation Code

IOU – Investor Owned Utility

kBtu – kilo-British thermal unit

kWh – Kilowatt Hour

LBNL – *Lawrence Berkeley National Laboratory*

LCC – Lifecycle Cost

LLAHU – Low Leakage Air Handler Unit

LSC – Long-term System Cost (2025 Title 24, Part 6 compliance metric)

MF – Multifamily

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 (2022 Title 24, Part 6 compliance metric)

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

VLLDCS – Verified Low Leakage Ducts in Conditioned Space

ZNE – Zero-net Energy

## Summary of Revisions

| Date      | Description            | Reference (page or section)   |
|-----------|------------------------|---|
| 9/12/2022 | Original Release (1.0) | N/A   |
| 3/25/2024 | Updated analysis (1.1) | <ul style="list-style-type: none"> <li>• New simulation results with latest CBECC-Res version (Section 2.1.1)</li> <li>• Updated utility cost estimates using recent utility tariff and net billing tariff (Section 2.1.3)</li> <li>• New measure costs for heat pumps, batteries, and PV (Section 3.3)</li> <li>• Revised packages (Section 3.4)</li> <li>• Revised Results, Summary, References, and Appendices (Sections 4-7)</li> </ul> |

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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-effectiveness analysis results for traditional new detached single family and detached accessory dwelling unit (ADUs) building types. It evaluates mixed fuel and all-electric package options in all sixteen California climate zones (CZs). Packages include combinations of efficiency measures, on-site renewable energy, and battery energy storage.

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. Time Dependent Valuation (TDV) is the California Energy Commission's LCC methodology, 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, Part 6.

The following are key takeaways and recommendations from the analysis.

### Conclusions and Discussion:

- All-electric buildings have lower GHG emissions than mixed fuel buildings, due to the clean power sources currently available from California's power providers as well as accounting for increased penetration of renewables in the future. Almost all the all-electric packages evaluated resulted in greater GHG emission savings than the mixed fuel packages, with the exception of the mixed fuel package with battery storage in climate zones with low heating loads.
- The Reach Codes Team found code-compliant all-electric new construction to be feasible and cost-effective based on TDV for single family homes in all cases except Climate Zone 16.
- All-electric single family new construction was On-Bill cost-effective in all cases except Climate Zones 1, 3, 14, and 16.
- The all-electric ADU home was cost-effective based on TDV in all cases except in Climate Zones 3, 4, 13, and 14 where the higher cost of installing a ducted heat pump water heater (HPWH) instead of the prescriptively required gas tankless water heater exceed the resulting energy cost savings. In the other climate zones there were first cost savings for installing a heat pump space heater instead of a gas furnace, contributing to an overall TDV cost-effective result.
- Few cases were cost-effective On-Bill for the ADU.
- All-electric code minimum construction results in an increase in first year utility costs relative to a mixed fuel home, except for CPAU and SMUD where electricity rates are much lower than for the investor-owned utilities (IOUs). The addition of efficiency measures, market dominant HPWHs that meet the Northwest Energy Efficiency Alliance's (NEEA's) Advanced Water Heating Specification<sup>1</sup>, high efficiency heat pumps, increased solar photovoltaics (PV), and batteries all reduce utility costs, and a combination of these options was found to reduce annual utility costs relative to a mixed fuel home in all cases.

---

<sup>1</sup> Refer to Section 0 for an explanation of HPWHs certified through NEEA's Advanced Water Heating Specification, their market status, and how they compare to federal minimum efficiency standards.

- Under the Net Billing Tariff (NBT)<sup>2</sup>, utility cost savings for increasing PV system size beyond code minimum 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 for the all-electric single family home. Coupling PV with battery systems increases utility cost savings as a result of improved on-site utilization of PV generation and fewer exports to the grid.
- Applying California Alternate Rates for Energy (CARE) rates in the IOU territories improves On-Bill cost-effectiveness for all-electric buildings, as compared to the same case under standard rates, due to higher utility cost savings compared to a code compliant mixed fuel building also on a CARE rate. This is due to the CARE discount on electricity being higher than that on gas.
- If gas tariffs are assumed to increase substantially over time, in line with the escalation assumption from the 2025 LSC development, all-electric new construction was found to be On-Bill cost-effective in almost all scenarios over the 30-year analysis period. There is much uncertainty surrounding future tariff structures as well as escalation values. While it's clear that gas rates are anticipated to increase, how much and how quickly is not known. Electricity tariff structures are expected to evolve over time, and the California Public Utilities Commission (CPUC) has an active proceeding to adopt an income-graduated fixed charge that benefits low-income customers and supports electrification measures<sup>3</sup>. 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 like incentivizing electrification, it also will make building efficiency measures harder to justify as cost-effective due to lower utility bill cost savings.

#### Recommendations:

- A reach code with a single performance target based on source energy (EDR1) can be structured to strongly encourage electrification. This approach requires equivalent performance for all buildings and allows mixed fuel buildings which minimizes the risk of violating federal preemption. Below are examples of how a reach code for single family homes could be set up based on the results summarized in Table 27.
  - A jurisdiction in Climate Zone 12 could set a performance target at an EDR1 margin of 11.5 (the EDR1 margin for the all-electric Code Minimum package). Any all-electric home meeting or exceeding the prescriptive requirements would comply, and a mixed fuel home would likely need to incorporate a combination of efficiency measures and a battery system to comply.
  - Similarly, a jurisdiction in Climate Zone 7 may consider setting a performance target of 2.8 EDR1 margin (also the EDR1 margin for the all-electric Code Minimum package). Any all-electric home meeting or exceeding the prescriptive requirements would comply, but a mixed fuel home would likely be able to comply with only a suite of above-code efficiency measures (no battery). Alternatively, a higher EDR1 margin target of 5 would incentivize more energy efficiency or additional PV for all-electric construction, and mixed fuel construction would likely need to incorporate a battery system to comply.
  - A jurisdiction in Climate Zone 16 may want to set a performance target at an EDR1 margin of 20.5 (the EDR1 margin for the mixed fuel efficiency + PV + battery package). This would establish a target that a mixed fuel home could cost-effectively meet, likely only after incorporating a combination of efficiency measures and a battery system, and that an all-electric home could easily meet.
- The 2022 Title 24 code's new source energy metric combined with the heat pump baseline encourage all-electric construction, providing an incentive that allows for some amount of prescriptively required building efficiency to be traded off, still meeting minimum code compliance. This compliance benefit for all-electric homes highlights a unique opportunity for jurisdictions to incorporate efficiency into all-electric reach codes. 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

<sup>2</sup> Refer to Section 2.1.3 for discussion on NBT and NEM

<sup>3</sup> <https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking>

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. The Reach Codes Team recommends that jurisdictions adopting a reach code for single family buildings also include an efficiency requirement with EDR1 margins at minimum consistent with the all-electric code minimum package results in Table 27.

- The code compliance margins for the ADU all-electric code minimum package are lower than for the single family prototype; code compliance and cost-effectiveness can be more challenging for smaller dwelling units. As a result, the Reach Codes Team does not recommend EDR1 targets above those reported for the all-electric Code Minimum package in Table 28.

This report presents measures or measure packages that local jurisdictions may consider adopting to achieve energy savings and emissions reductions beyond what will be accomplished by enforcing minimum state requirements, the 2022 Building Energy Efficiency Standards (Title 24, Part 6), effective January 1, 2023.

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, jurisdictions may amend Part 11 instead of Part 6 of the CA Building Code requiring review and approval by the Building Standards Commission (BSC) but not the California Energy Commission (Energy Commission). 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. 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.

Model ordinance language and other resources are posted on the C&S Reach Codes Program website at [LocalEnergyCodes.com](https://www.localenergycodes.com). Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at [info@localenergycodes.com](mailto:info@localenergycodes.com). In addition, jurisdictions in a CCA territory with rates or rate structures that are significantly different than IOU rates may email the program at [info@localenergycodes.com](mailto:info@localenergycodes.com) to request a custom analysis.

# 1 Introduction

This report documents cost-effective combinations of measures that exceed the minimum state requirements, the 2022 Building Energy Efficiency Standards, effective January 1, 2023, for newly constructed single family buildings. This report was developed in coordination with the California Statewide Investor-Owned Utilities (CA IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Reach Codes Team.

The analysis considers traditional detached single family and detached accessory dwelling unit (ADUs) building types and evaluates mixed fuel and all-electric package options in all sixteen California climate zones (CZs).<sup>4</sup> Packages include combinations of efficiency measures, on-site renewable energy, and battery energy storage.

This report documents the key results and conclusions from the Reach Codes Team analysis. A full dataset of all results can be downloaded from the Local Energy Codes [Resources](https://localenergycodes.com/resources)<sup>5</sup> webpage. Results alongside policy options and the potential citywide impacts for specific jurisdictions can also be explored using the Cost-effectiveness Explorer at <https://explorer.localenergycodes.com/>.

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (California Energy Commission, 2021a) is maintained and updated every three years by two state agencies: the California Energy Commission (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 — herein referred to as federal preemption — 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 measures 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.

<sup>4</sup> See Appendix 7.1 Map of California Climate Zones for a graphical depiction of climate zone locations.

<sup>5</sup> <https://localenergycodes.com/content/resources/?q=newly%20constructed%20buildings:%20efficiency%20and%20electrification>

## 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 software approved for 2022 Title 24 Code compliance analysis, CBECC-Res 2022.3.0.

The general approach applied in this analysis is to evaluate performance and determine cost-effectiveness of various energy efficiency upgrade measures, individually and as packages, in single family buildings. Using the 2022 baseline as the starting point, prospective measures and packages were identified and modeled in each of the prototypes to determine the projected energy use (therm and kWh) and compliance impacts. A large set of parametric runs were conducted to evaluate various options and develop packages of measures that met or exceeded minimum code performance. The analysis utilized a Python based parametric tool to automate and manage the generation of CBECC-Res input files. This allowed for quick evaluation of various efficiency measures across multiple climate zones and prototypes and improved quality control. The batch process functionality of CBECC-Res was utilized to simulate large groups of input files at once.

#### 2.1.2 Cost-effectiveness

##### 2.1.2.1 Benefits

This analysis used two different metrics to assess 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 manner in which they value energy and thus the cost savings of reduced or avoided energy use:

**Utility Bill Impacts (On-Bill):** 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. Total savings are estimated over a 30-year duration and include discounting of future costs and energy cost inflation.

**Time Dependent Valuation (TDV):** Energy Commission LCC methodology, which is intended to capture the total value or cost of energy use over 30 years. This method accounts for long-term projected costs, such as the cost of providing energy during peak periods of demand, and other societal costs, such as projected costs for carbon emissions as well as grid transmission and distribution impacts. This metric values energy use differently depending on the fuel source (natural gas, electricity, and propane), time of day, and season. For example, electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods due to the less inefficient energy generation sources providing peak electricity (Horii, Cutter, Kapur, Arent, & Conotyannis, 2014). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in Title 24, Part 6.

##### 2.1.2.2 Costs

The Reach Codes Team assessed the incremental costs of the measures and packages over a 30-year lifecycle. 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 calculating On-Bill cost-effectiveness, incremental first costs were assumed to be financed into a mortgage or loan with a 30-year loan term and four percent interest rate. Financing was not applied to future replacement or maintenance costs. In calculating TDV cost-effectiveness, incremental first costs were not assumed to be financed into a mortgage or loan.

### 2.1.2.3 Metrics

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

**NPV Savings:** The lifetime NPV savings is reported as a cost-effectiveness metric; Equation 1 demonstrates how this is calculated. If the net savings of a measure or package is positive, it is considered cost-effective. Negative savings represent net costs.

**B/C Ratio:** Ratio of the present value of all benefits to the present value of all costs over 30 years (present value of benefits divided by present value of costs). The criteria benchmark for cost-effectiveness is a B/C ratio greater than one. A value of one indicates the present value of the savings over the analysis period is equivalent to the present value 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

$$NPV \text{ Savings} = \text{Present value of lifetime benefit} - \text{Present value of lifetime cost}$$

#### Equation 2

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

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 TDV savings, and the cost is represented 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), B/C ratio cost-effectiveness is represented by ">1".

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

#### Equation 3

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

Where:  $n$  = analysis term in years

- $r$  = discount rate

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

- Analysis term of 30 years
- Real discount rate of three percent

TDV is a normalized monetary format and there is a unique procedure for calculating the present value benefit of TDV energy savings. The present value of the energy cost savings in dollars is calculated by multiplying the TDV savings (reported by the CBECC-Res simulation software) by a NPV factor developed by the Energy Commission (see (Energy + Environmental Economics, 2020)). The 30-year residential NPV factor is \$0.173/kTDV kBtu for the 2022 code cycle.

#### Equation 4

- $TDV \text{ PV of lifetime benefit} = TDV \text{ energy savings} * NPV \text{ factor}$

### 2.1.3 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 in order to calculate utility costs and determine On-Bill cost-effectiveness for the proposed measures and packages. The utility tariffs, summarized in Table 1, were determined based on the most prevalent active rate 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/SoCalGas and SDG&E tariffs 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.

Some community choice aggregations (CCAs) have utility rates that are very similar to IOU rates, often within \$0.02 per kWh. For these CCA customers, total utility costs will be very similar to those calculated in this study and the results from this study will generally apply. The study results cannot be easily applied to CCAs with rates that do not closely track the IOU rates or municipal utilities outside of SMUD and CPAU.

First-year utility costs were calculated using hourly electricity and natural gas output from CBECC-Res and applying the utility tariffs summarized in Table 1. Annual costs were also estimated for IOU customers eligible for the CARE tariff discounts on both electricity and natural gas bills. Appendix 7.2 Utility Rate Schedules includes details of each utility tariff. For cases with onsite generation (i.e. solar photovoltaics (PV)), the approved Net Billing Tariff (NBT) was applied along with monthly service fees and hourly export compensation rates for 2024<sup>6</sup>. In December 2022, the California Public Utilities Commission (CPUC) issued a decision adopting NBT as a successor to prior net energy metering rules (NEM 2.0) that went into effect April of 2023.<sup>7</sup> The ADU was assumed to have separate electric and gas meters from the main house.

**Table 1: Utility Tariffs Used Based on Climate Zone**

| Climate Zones   | Electric / Gas Utility | Electricity Tariff   | Natural Gas Tariff |
|-----------------|------------------------|--|--------------------|
| <b>IOUs</b>     |                        |  |                    |
| 1-5,11-13,16    | PG&E / PG&E            | E-ELEC   | G1                 |
| 5               | PG&E / SoCalGas        | E-ELEC   | GR                 |
| 6, 8-10, 14, 15 | SCE / SoCalGas         | TOU-D-PRIME  | GR                 |
| 7, 10, 14       | SDG&E / SDG&E          | EV-TOU-5 (TOU-ELEC for ADU cases without PV systems <sup>8</sup> ) | GR                 |
| <b>POUs</b>     |                        |  |                    |
| 4               | CPAU / CPAU            | E-1  | G1                 |
| 12              | SMUD / PG&E            | R-TOD  | G1                 |

Utility rates are assumed to escalate over time according to 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. A second set of escalation rates were also evaluated to demonstrate the impact that utility cost changes over time have on cost-effectiveness. This utility rate escalation sensitivity analysis, presented in Section 4.6.3, was based on those used within the 2025 Long-

<sup>6</sup> <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/net-energy-metering-nem/nemrevisit/nbt-model--12142022.xlxb>

<sup>7</sup> <https://www.cpuc.ca.gov/nemrevisit>

<sup>8</sup> See Section 3.2 Prototype Characteristics for a description of ADU cases that don't require solar PV prescriptively.

term System Cost (LSC) factors (LSC replaces TDV in the 2025 code cycle) which assumed steep increases in gas rates in the latter half of the analysis period. See Appendix 7.2.7 Fuel Escalation Assumptions for details.

## 2.2 Greenhouse Gas Emissions

The analysis reports the greenhouse gas (GHG) emission estimates based on assumptions within CBECC-Res. There are 8,760 hourly multipliers accounting for time-dependent energy use and carbon based on source emissions, including renewable portfolio standard projections. There are two strings of multipliers—one for Northern California climate zones, and another for Southern California climate zones.<sup>9</sup> GHG emissions are reported as average annual metric tons of CO<sub>2</sub> equivalent over the 30-year measure analysis period.

## 2.3 Energy Design Rating

The 2019 Title 24 Code introduced California’s Energy Design Rating (EDR) as the primary metric to demonstrate compliance with the energy code for single family buildings. This EDR was based on the hourly TDV energy use from a building that is compliant with the 2006 International Energy Conservation Code (IECC) as the Reference Building. The Reference Building has an EDR score of 100 while a zero-net energy (ZNE) home has an EDR score of zero. While the Reference Building is used to set the scale for the rating, the Proposed Design is still compared to the Standard Design based on the Title 24 prescriptive baseline assumptions to determine compliance. In the 2022 Title 24 Code a second new EDR metric was introduced based on hourly source energy. The two EDR metrics are described below:

- EDR1 is calculated based on source energy.
- EDR2 is calculated based on TDV energy.

EDR1 has only one component, “Total EDR1” which represents source energy use for the entire building. EDR2 is composed of two components for compliance purposes: the “Efficiency EDR2”, which represents the energy efficiency features of a home, and the PV/Flexibility EDR2, which includes the effects of PV and battery storage systems. “Total EDR2” combines all energy use of the building including both the Efficiency and PV/Flexibility impacts. While the Efficiency EDR2 does not include the full impact of a battery system, it can include a self-utilization credit for batteries if certain conditions are met.

For a new, single family building to comply with the 2022 Title 24 Code, three criteria must be met:

1. The Proposed Total EDR1 must be equal to or less than the Total EDR1 of the Standard Design, and
2. The Proposed Efficiency EDR2 must be equal to or less than the Efficiency EDR2 of the Standard Design, and
3. The Proposed Total EDR2 must be equal to or less than the Total EDR2 of the Standard Design.

This concept, consistent with California’s “loading order” which prioritizes energy efficiency ahead of renewable generation, requires projects to meet a minimum Efficiency EDR2 before PV is credited but allows for PV to be traded off with additional efficiency when meeting the Total EDR2. A project may improve building efficiency beyond the minimum required and subsequently reduce the PV generation capacity necessary to achieve the required Total EDR2. However, it may not increase the size of the PV system and trade this off with a reduction of efficiency measures.

Results from this analysis are presented as EDR Margin, a reduction in the EDR score relative to the Standard Design. EDR Margin is a better metric to use than absolute EDR in the context of a reach code because absolute values vary based on the home design and characteristics such as size and orientation. This approach aligns with how compliance is reported for the 2019 and 2022 Title 24 Code. The EDR Margin is calculated according to Equation 5.

### Equation 5

$$EDR\ Margin = Standard\ Design\ EDR - Proposed\ Design\ EDR$$

<sup>9</sup> CBECC-Res multipliers are the same for CZs 1-5 and 11-13 (Northern California), while there is another set of multipliers for CZs 6-10 and 14-16 (Southern California).

## 3 Prototypes, Measure Packages, and Costs

This section describes the prototypes and the scope of analysis drawing from previous research where necessary, including the 2019 low-rise residential single family reach code study (Statewide Reach Codes Team, 2019).

### 3.1 Prior Reach Code Research

In 2019, the Reach Codes Team analyzed the cost-effectiveness of residential single family new construction projects for mixed fuel and all-electric packages (Statewide Reach Codes Team, 2019). Using this analysis, several cities and counties in California adopted local energy code amendments encouraging or requiring that low-rise residential new construction be all-electric. As there were few changes to the single family requirements, this analysis for the 2022 code cycle leveraged the work completed for the 2019 reports. Initial efficiency packages were based on the final packages from the 2019 research and were revised to reflect measure specifications and costs based on new data.

### 3.2 Prototype Characteristics

The Energy Commission defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. For the 2022 code cycle the Energy Commission used two single family prototypes, both of which were used in this analysis. Additional details on the prototypes can be found in the Alternative Calculation Method (ACM) Approval Manual (California Energy Commission, 2018).

Additionally, a detached new construction ADU prototype was developed to reflect recent trends in California construction related to the high cost of housing (TRC, 2021). ADUs are additional dwelling units typically built on the property of an existing single-family parcel. ADUs are defined as new construction in the energy code when they are ground-up developments, do not convert an existing space to livable space, and are not attached to the primary dwelling. The evaluated prototype is not representative of an attached ADU constructed as an addition to an existing home.

The Reach Codes Team leveraged prior research to define the detached ADU baseline and measure packages. The house size and number of bedrooms were based on data from a survey conducted by UC Berkeley's Center for Community Innovation (UC Berkeley Center for Community Innovation, 2021). The survey found that the average square footage for new ADUs statewide is 615 square feet and that the majority (61 percent) of new ADUs have one bedroom.

Table 2 describes the basic characteristics of each prototype. The prototypes have equal geometry on all walls, windows and roof to be orientation neutral.

**Table 2: Prototype Characteristics**

| Characteristic             | Single Family One-Story | Single Family Two-Story | ADU                 |
|----------------------------|-------------------------|-------------------------|---------------------|
| Conditioned Floor Area     | 2,100 ft <sup>2</sup>   | 2,700 ft <sup>2</sup>   | 625 ft <sup>2</sup> |
| Num. of Stories            | 1                       | 2                       | 1                   |
| Num. of Bedrooms           | 3                       | 4                       | 1                   |
| Window-to-Floor Area Ratio | 20%                     | 20%                     | 19.2%               |

The Energy Commission's protocol for the two single family prototypes is to weigh the simulated energy impacts by a factor that represents the distribution of single-story and two-story homes being built statewide. Consistent with this protocol, this study assumed 50 percent single-story and 50 percent two-story. Simulation results in this study are

characterized and presented according to this ratio, which is approximately equivalent to a 2,400-square foot (ft<sup>2</sup>) house.<sup>10</sup> ADU results are presented separately.

The methodology used in the analyses for each of the prototypical building types begins with a design that precisely meets the minimum 2022 prescriptive requirements (zero compliance margin). Table 150.1-A in the 2022 Standards (California Energy Commission, 2021a) lists the prescriptive measures that determine the baseline design in each climate zone. Other features are consistent with the Standard Design in the ACM Reference Manual (California Energy Commission, 2022), and are designed to meet, but not exceed, the minimum requirements. See Appendix 7.4 for a list of prescriptive values relevant to the measures explored in this analysis.

Table 3 describes additional characteristics as they were applied to the base case, or baseline, energy model in this analysis. In a shift from the 2019 Standards, the 2022 Standards apply a prescriptive fuel source for space heating and water, where one is gas-fueled and one is a heat pump depending on climate zone. This establishes a prescriptive heat pump baseline. In most climate zones the prescriptive base case includes a heat pump water heater and a natural gas furnace for space heating. In Climate Zones 3, 4, 13, and 14 this is reversed, where the base case has a heat pump space heater and natural gas tankless water heater.

Table 4 summarizes the PV capacities for the base case packages.

<sup>10</sup> 2,400 ft<sup>2</sup> = (50% x 2,100 ft<sup>2</sup>) + (50% x 2,700 ft<sup>2</sup>)

**Table 3: Base case Characteristics of the Prototypes**

| Characteristic                       | Single Family   | ADU   |
|--------------------------------------|---|---|
| Space Heating/Cooling <sup>1,2</sup> | <u>CZs 1-2,5-12,15-16</u> : Natural gas furnace, split AC 80 AFUE, 14.3 SEER2, 11.7 EER2<br><u>CZs 3-4,13-14</u> : Split heat pump – 7.5 HSPF2, 14.3 SEER2, 11.7 EER2   | Same as single family   |
| Air Distribution                     | <u>Ductwork located in vented attic</u>   | Same as single family   |
| Water Heater <sup>1,2</sup>          | <u>CZs 1-2,5-12,15-16</u> : Heat pump water heater (HPWH) UEF = 2.0 located in the garage<br><u>CZs 3-4,13-14</u> : Natural gas tankless – UEF = 0.81   | Same equipment type as SF except HPWH is located inside the conditioned space with the supply air ducted from outside and exhaust air ducted to outside. <sup>3</sup>   |
| Hot Water Distribution               | Code minimum<br><u>CZs 1,16</u> : Basic compact distribution credit   | Same as single family   |
|                                      |   |   |
| Cooking                              | Natural Gas   | Same as single family   |
| Clothes Drying                       | Natural Gas   | Same as single family   |
| PV System                            | Sized to offset 100% of electricity use for space cooling, ventilation, lighting, appliance, & other miscellaneous electric loads. Size differs by climate zone ranging from 2.64 kW to 5.21 kW, see Table 4. | PV is not required when the PV system size required based on the prescriptive calculations is less than 1.8 kW, as is the case in Climate Zones 1-9, 12, 14, and 16. In the other climate zones the PV size ranges from 1.73 kW to 2.51 kW, see Table 4. <sup>4</sup> |
| Foundation                           | Slab-on-grade   | Same as single family   |

<sup>1</sup> Equipment efficiencies are equal to minimum federal appliance efficiency standards.

<sup>2</sup> AFUE = annual fuel utilization efficiency. SEER = seasonal energy efficiency ratio. EER = energy efficiency ratio. HSPF = heating seasonal performance factor. UEF = uniform energy factor.

<sup>3</sup> This version of CBECC-Res used in this analysis did not have the capability to directly model ducted HPWHs even though this configuration is called out as the Standard Design in the 2022 ACM (California Energy Commission, 2022). This was modeled by indicating that the tank is located within the conditioned space with the compressor unit located outside.

<sup>4</sup> Exception 2 to Section 150.1(l)14 states that “no PV system is required when the minimum PV system size specified by section 150.1(c)14 is less than 1.8 kWdc.” In this analysis this exception is applied based on the sizes calculated per Equation 150.1-C of Section 150.1(c)14. The performance software sizes the PV system based on the estimated energy use, which differs slightly from the prescriptive sizing. As a result, the baseline PV capacity from the performance software for Climate Zone 10 is less than 1.8 kWdc.

**Table 4: Base Package PV Capacities (kW-DC)**

| Climate Zone | Base Package  |      |
|--------------|---------------|------|
|              | Single Family | ADU  |
| CZ01         | 3.57          | 0    |
| CZ02         | 3.03          | 0    |
| CZ03         | 2.83          | 0    |
| CZ04         | 2.91          | 0    |
| CZ05         | 2.64          | 0    |
| CZ06         | 2.65          | 0    |
| CZ07         | 2.83          | 0    |
| CZ08         | 3.11          | 0    |
| CZ09         | 2.96          | 0    |
| CZ10         | 3.17          | 1.73 |
| CZ11         | 3.90          | 2.06 |
| CZ12         | 3.14          | 0    |
| CZ13         | 4.05          | 2.09 |
| CZ14         | 3.15          | 0    |
| CZ15         | 5.21          | 2.51 |
| CZ16         | 2.93          | 0    |

### 3.3 Measure Definitions and Costs

Measures evaluated in this study fall into two categories: those associated with general efficiency — onsite generation (solar PV), and demand flexibility (batteries) — and those associated with building electrification. Furthermore, general efficiency measures are broken into those that are federally preempted and those that are not; see Section 1 for background information on preemption and Section 3.4 for details of measure packages evaluated in this study. The Reach Codes Team selected measures based on cost-effectiveness as well as decades of experience with residential architects, builders, and engineers along with general knowledge of the relative consumer acceptance of many measures.

The following sections describe the details and incremental cost assumptions for each of the measures. Incremental costs represent the equipment, installation, replacement, and maintenance costs of the proposed measures relative to the base case.<sup>11</sup> Replacement costs are applied for roofs, mechanical equipment, PV inverters and battery systems over the 30-year evaluation period. Maintenance costs are estimated for PV systems, but not any other measures. Costs were estimated to reflect costs to the building owner. All costs are provided as present value in 2023 (2023 PV\$).

The Reach Codes Team obtained measure costs from distributors, contractors, literature review, and online sources such as Home Depot and RS Means. Contractor markups are incorporated. These are the Reach Codes Team's best estimates of average costs statewide. However, it's recognized that local costs may differ, and that inflation and supply chain issues may also impact costs.

#### 3.3.1 Efficiency, Solar PV, and Batteries

The following are descriptions of each of the efficiency, PV, and battery measures evaluated under this analysis and applied in at least one of the packages presented in this report, including how they compare to the current prescriptive requirements. Throughout this report, "Efficiency" measures refer specifically to the following non-preempted

<sup>11</sup> All first costs are assumed to be financed in a mortgage and interest costs due to financing are included in the incremental costs. See Section 2.1.2 for details.

measures. These measures are in addition to or in place of the relevant 2022 base case prototype characteristics outlined in Table 3, and their applicability to measure packages are summarized in Table 39 through Table 41. Table 5 summarizes the incremental cost assumptions for each of these measures.

**Reduced Infiltration (ACH50):** Reduce infiltration in single family homes from the default infiltration assumption of five (5) air changes per hour at 50 Pascals (ACH50)<sup>12</sup> by 40 percent to 3 ACH50. HERS rater field verification and diagnostic testing of building air leakage according to the procedures outlined in the 2022 Reference Appendices RA3.8 (California Energy Commission, 2021b).

**Lower U-Factor Fenestration:** Reduce window U-factor to 0.24. The prescriptive U-factor is 0.30 in all climate zones.

**Higher SHGC Fenestration:** Increase solar heat gain coefficient (SHGC) to 0.50 in climate zones where heating loads dominate (1, 3, 5 and 16). The baseline SHGC applied in the Standard Design is 0.35 in these climate zones.

**Cool Roof:** Install a roofing product that's rated by the Cool Roof Rating Council to have an aged solar reflectance (ASR) equal to or greater than 0.25. Steep-sloped roofs were assumed in all cases. The prescriptive ASR is 0.20 for Climate Zones 10 through 15.

**Increased Ceiling Insulation:** Increase ceiling level insulation in a vented attic to R-38, R-49, or R-60 insulation.

**Slab Insulation:** Install R-10 perimeter slab insulation at a depth of 16-inches. This measure doesn't apply to Climate Zone 16 where slab insulation is required prescriptively.

**Low Pressure Drop Ducts:** Upgrade the duct distribution system to reduce external static pressure and meet a maximum fan efficacy of 0.35 Watts per cfm (compared to the prescriptively required 0.45 W/cfm). This may involve upsizing ductwork, reducing the total effective length of ducts, and/or selecting low pressure drop components such as filters. Fan watt draw must be verified by a HERS rater according to the procedures outlined in the 2022 Reference Appendices RA3.3 (California Energy Commission, 2021b). This applies to the single family prototype only.

**Buried Radial Duct Design:** Bury all ductwork in ceiling insulation by laying the ducts across the ceiling joists or in-between ceiling joists directly on the ceiling drywall. Duct design is based on a radial design where individual ducts are run to each supply register. This allows for smaller diameter ducts, reducing duct losses and more easily meeting fully or deeply buried conditions.<sup>13</sup> Duct burial and duct system design must be verified by a HERS rater according to the procedures outlined in the 2022 Reference Appendices RA3.1.4.1.5 and RA3.1.4.1.6 (California Energy Commission, 2021b). This applies to the single family prototype only.

**Ductless Mini-Split Heat Pump:** In the ADU prototype install a ductless mini-split heat pump with three indoor heads. The system is evaluated as meeting the criteria for the variable capacity heat pump (VCHP) credit, introduced in the 2019 code cycle, which must be verified by a HERS rater according to the procedures outlined in the 2022 Reference Appendices RA3.4.4.3 (California Energy Commission, 2021b). This credit requires verification of refrigerant charge, that all equipment is entirely within conditioned space, that airflow is directly supplied to all habitable space, and that wall mounted thermostats serve any zones greater than 150 square feet. This measure is non-preempted because it does not require the installation of equipment with efficiencies above federal minimum requirements.

**Compact Hot Water Distribution:** Design the hot water distribution system to meet minimum requirements for the basic compact hot water distribution credit according to the procedures outlined in the 2022 Reference Appendices RA4.4.6 (California Energy Commission, 2021b). In many single family homes this may require moving the water heater from an exterior to an interior garage wall. CBECC-Res software assumes a 30% reduction in distribution losses for the basic credit. This is prescriptively required in Climate Zones 1 and 16 only.

**Solar PV:** Installation of on-site PV is required in the 2022 residential code unless an exception is met. The PV sizing methodology in each package was developed to offset annual building electricity use and avoid oversizing. In all cases,

<sup>12</sup> Whole house leakage tested at a pressure difference of 50 Pascals between indoors and outdoors.

<sup>13</sup> The duct systems in the Central Valley Research Homes Project Final Project Report are illustrative of this approach (Proctor, Wilcox, & Chitwood, 2018).

PV is evaluated in CBECC-Res according to the California Flexible Installation (CFI) 1 assumptions. To meet CFI eligibility, the requirements of 2022 Reference Appendices JA11.2.2 (California Energy Commission, 2021b) must be met.

The Reach Codes Team used two options within the CBECC-Res software for sizing the PV system. The first option, “Standard Design PV”, was applied in the base case simulations and packages where the PV system size was not changed from the minimum system size required<sup>14</sup>. For the PV packages, the second option, “Specify PV System Scaling”, was used. In these cases, a scaling of 100 was applied, indicating that the PV system be sized to offset 100% of the estimated electricity use of the Proposed Design case.

One exception to the PV requirement is when the minimum PV system size required is less than 1.8 kW. This exception applies to the ADU models in Climate Zones 1-9, 12, 14, and 16. For these cases no PV system is required by code and no PV system was modeled in the base case simulations.

**Battery Energy Storage:** A 10 kWh battery system was evaluated in CBECC-Res with control type set to “Basic” and with default efficiencies of 95% for both charging and discharging. 10kWh battery capacity is representative of systems installed in single family homes based on the Self-Generation Incentive Program (SGIP) participant data. The “Basic” control option charges the battery system anytime PV generation is greater than the house load and discharges the battery whenever the house load exceeds PV generation. The battery does not discharge to the grid, maximizing on-site utilization of the PV system and in turn utility bill benefits under NBT. To qualify for the battery storage compliance credit the battery system must meet the requirements outlined in the 2022 Reference Appendices JA12 (California Energy Commission, 2021b). Batteries are not prescriptively required in any climate zone.

**Table 5: Incremental Cost Assumptions: Efficiency, PV, and Battery Measures**

| Measure              | Performance Level                   | Incremental Cost (2023 PV\$) <sup>1</sup> |       | Source & Notes   |
|----------------------|-------------------------------------|---|-------|--|
|                      |                                     | Single Family                             | ADU   |  |
| Reduced Infiltration | 3.0 vs 5.0 ACH50                    | \$591                                     | \$362 | \$0.115/ft <sup>2</sup> based on NREL’s BEopt cost database plus \$250 HERS rater verification.  |
| Window U-factor      | 0.24 vs 0.30                        | \$2,280                                   | \$285 | \$4.23/ft <sup>2</sup> window area based on analysis conducted for the 2019 and 2022 Title 24 cycles (Statewide CASE Team, 2018).  |
| Window SHGC          | 0.50 vs 0.35                        | \$0                                       | \$0   | Based on feedback from Statewide CASE Team that higher SHGC does not necessarily have any incremental cost (Statewide CASE Team, 2017).  |
| Cool Roof            | 0.25 vs 0.20 aged solar reflectance | \$219                                     | \$53  | \$0.07per ft <sup>2</sup> of roof area first incremental cost for asphalt shingle product based on the 2022 Nonresidential High Performance Envelope CASE Report (Statewide CASE Team, 2020a). Total costs assume present value of replacement at year 20 and residual cost for remaining product life at end of 30-year analysis period. Higher reflectance values for lower cost are achievable for tile roof products |
| Attic Insulation     | R-49 vs R-30                        | \$872                                     | n/a   | Based on costs from the 2022 Residential Additions & Alterations CASE Report (Statewide CASE Team, 2020b).   |
|                      | R-60 vs R-30                        | \$1,420                                   | n/a   |  |
|                      | R-60 vs R-38                        | \$1,096                                   | n/a   |  |
| Slab Edge Insulation | R-10 vs R-0                         | \$651                                     | \$449 | \$4 per linear foot of slab perimeter based on internet research. Assumes 16in depth.  |

<sup>14</sup> The Standard Design PV system is sized to offset the electricity use of the building loads which are typically electric in a mixed fuel home, which includes all loads except space heating, water heating, clothes drying, and cooking.

| Measure                        | Performance Level  | <u>Incremental Cost (2023 PV\$)<sup>1</sup></u> |           | Source & Notes  |
|--------------------------------|--|---|-----------|---|
|                                |  | Single Family                                   | ADU       |   |
| Low Pressure Drop Ducts        | 0.35 vs 0.45 W/cfm   | \$99  | n/a       | Costs assume one-hour labor for single family and half-hour for the ADU. Labor rate of \$88 per hour is from 2022 RS Means for sheet metal workers and includes a weighted average City Cost Index for labor for California.  |
| Buried Ducts                   | Buried, radial design  | \$281   | n/a       | No cost for laying ducts on attic floor versus suspending, in some cases there will be cost savings. Neutral cost for radiant design versus trunk and branch design. A \$250 HERS Rater verification fee is included.   |
| Duct Insulation                | R-8 vs R-6   | \$201   | n/a       | Based on costs from the 2022 Residential Additions & Alterations CASE Report (Statewide CASE Team, 2020b).  |
| Ductless Mini-Split Heat Pump  | Ductless system meeting the VCHP credit vs. ducted split heat pump | n/a   | \$1,571   | Costs were developed based on data from E3's 2019 report Residential Building Electrification in California (Energy & Environmental Economics, 2019) and the 2022 All-Electric Multifamily CASE Report (Statewide CASE Team, 2020c). Equipment costs are from the CASE Report for the 10-story multifamily prototype assuming similar sized equipment between the multifamily dwelling unit and the ADU. Thermostat, wiring, electrical, and ducting costs are from the E3 study. A \$250 HERS Rater verification fee is also included. Where this measure is applied to the mixed fuel home with a gas furnace, this cost is in addition to the cost difference for a heat pump versus a gas furnace/split AC reported in Section 3.3.2. |
| Compact Hot Water Distribution | Basic credit – homes with gas tankless                             | \$196   | \$0       | For single family homes with a gas tankless water heater (mixed fuel homes in Climate Zones 3, 4, 13, 14) assumes adding 20-feet venting at \$14.69 per linear foot to locate water heater on interior garage wall, less 20-feet savings for PEX and pipe insulation at \$5.98 per linear foot. Costs obtained from online retailers. For single family homes with a HPWH there is an incremental cost savings from less pipe being required. For the ADU it is assumed the credit can be met without any changes to design and there is no cost impact.  |
|                                | Basic credit – homes with HPWH                                     | -\$134  | \$0       |   |
| PV System                      | First Cost   | \$3.11/W  | \$3.11/W  | First costs are from LBNL's Tracking the Sun 2022 (Barbose, Galen; Darghouth, Naim; O'Shaughnessy, Eric; Forrester, Sydney, 2022) and represent median costs in California in 2022 of \$3.78/WDC for residential systems. The first cost was reduced by the solar energy Investment Tax Credit of 30%. <sup>2</sup> Inverter replacement cost of \$0.14/WDC present value includes replacements at year 11 at \$0.15/WDC (nominal) and at year 21 at \$0.12/WDC (nominal) per the 2019 PV CASE Report (California Energy Commission, 2017). System maintenance costs of \$0.31/WDC present value assume \$0.02/WDC (nominal) annually per the 2019 PV CASE Report (California Energy Commission, 2017).                                   |
|                                | Inverter replacement   | \$0.14/W  | \$0.14/W  |   |
|                                | Maintenance  | \$0.31/W  | \$0.31/W  |   |
|                                | Replacement cost   | \$648/kWh                                       | \$648/kWh |   |

| Measure          | Performance Level | Incremental Cost (2023 PV\$) <sup>1</sup> |           | Source & Notes  |
|------------------|-------------------|---|-----------|---|
|                  |                   | Single Family                             | ADU       |   |
| Battery (10 kWh) | First cost        | \$782/kWh                                 | \$782/kWh | <p>First costs of \$1,101/kWh are from SGIP residential participant cost data for single family projects between 2020 and 2023. The first cost is reduced by 30% due to the Investment Tax Credit<sup>2</sup> and also by \$0.15/Wh due to the base SGIP incentive<sup>3</sup>. The SGIP incentive is only accounted for in IOU territories and not for SMUD and CPAU analyses.</p> <p>Replacement cost at years 10 and 20 was calculated based on the first cost reduced by 7% annually over the next 10 years for a future value cost of \$533/kWh. The 7% reduction is based on SDG&amp;E's Behind-the-Meter Battery Market Study (E-Source companies, 2020). For projects constructed in 2024 or 2025, the first replacement at year 10 would occur in 2034 or 2035. This replacement cost includes an average Investment Tax Credit of 22% in 2034 and 0% in 2035<sup>2</sup>.</p> |

<sup>1</sup>All first costs are assumed to be financed in a mortgage and interest costs due to financing are included in the incremental costs. See Section 2.1.2 for details. Interest costs were not included for calculating TDV cost-effectiveness.

<sup>2</sup>As part of the Inflation Reduction Act in August 2022 the Section 25D Investment Tax Credit was extended and raised to 30% through 2032 with a step-down beginning in 2033. <https://www.seia.org/sites/default/files/2022-08/Inflation%20Reduction%20Act%20Summary%20PDF%20FINAL.pdf>

<sup>3</sup>SGIP incentives vary by 'steps' which reflect utility-specific funding across program implementation years. See: [https://www.selfgenca.com/home/program\\_metrics/](https://www.selfgenca.com/home/program_metrics/)

### 3.3.2 Electrification

This analysis compared a code compliant mixed fuel prototype, which uses natural gas for three appliances (cooking, clothes drying and either space heating or water heating), with a code compliant all-electric prototype. The associated costs included the relative costs between natural gas and electric appliances, differences between in-house electricity and natural gas infrastructure, and the associated infrastructure costs for providing natural gas to the building. To estimate costs the Reach Codes Team leveraged costs from the 2019 reach code cost-effectiveness studies for residential new construction (Statewide Reach Codes Team, 2019) and detached accessory dwelling units (Statewide Reach Codes Team, 2021b), 2022 RS Means, PG&E data, published utility schedules and rules, and online research.

#### 3.3.2.1 Utility Infrastructure

This section addresses utility infrastructure costs during construction; appliance-specific infrastructure costs are addressed in Section 0. Table 6 presents total costs for natural gas infrastructure for a single family building within CA gas IOU territory, including distribution and service line extensions, meter installation, and plan review. These costs are applied as cost savings for an all-electric home when compared to a mixed fuel home. This is the component with the highest degree of variability for all-electric homes, as they are project-dependent and may be significantly impacted by such factors as utility territory, site characteristics, distance to the nearest natural gas main and main location, joint trenching, whether work is conducted by the utility or a private contractor, and number of dwelling units per development. All gas utilities participating in this study were solicited for cost information. The CA IOU costs for single family homes presented are based on cost data provided by PG&E.

Extension of service lines from a main distribution line to the home were provided separately for a new subdivision in an undeveloped area (\$1,300) as well as an infill development (\$6,750). The service extension is typically more costly in an infill scenario due to the disruption of existing roads, sidewalks, and other structures. For this analysis an average of the new subdivision and infill development costs was used, representing 80 percent of the new subdivision and 20 percent infill. In the case of distribution line extensions, the estimated cost is for new greenfield development.

For the single family analysis, based on the Reach Codes Team's conversations with the industry it is assumed that no upgrades to the electrical panel are required and that a 200 Amp panel is typically installed for both mixed fuel and all-electric homes.

**Table 6: Single Family IOU Total Natural Gas Infrastructure Costs**

| Item                        | Cost           |
|-----------------------------|----------------|
| Distribution Line Extension | \$1,020        |
| Service Line Extension      | \$2,390        |
| Meter                       | \$300          |
| Plan Review Costs           | \$850          |
| <b>Total</b>                | <b>\$4,560</b> |

CPAU provides gas service to its customers and therefore separate costs were evaluated based on CPAU gas service connection fees.<sup>15</sup> Table 7 presents the breakdown of gas infrastructure costs used in this analysis for CPAU. There is no main distribution line component since Palo Alto has little greenfield space remaining and most of the development is infill.

<sup>15</sup> CPAU Schedule G-5 effective 09-01-2019: <https://www.cityofpaloalto.org/files/assets/public/utilities/utilities-engineering/general-specifications/gas-service-connection-fees.pdf>

**Table 7: Single Family CPAU Total Natural Gas Infrastructure Costs**

| Item              | Cost           |
|-------------------|----------------|
| Service Extension | \$5,892        |
| Meter             | \$1,012        |
| Plan Review Costs | \$924          |
| <b>Total</b>      | <b>\$7,828</b> |

Electricity infrastructure costs for single family homes were not estimated as part of this work as they are expected to be the same for both all-electric and mixed fuel construction. This will change in July 2024 based on the CPUC's recent decision to eliminate electric line extension subsidies for new construction projects that use natural gas and/or propane.<sup>16</sup> This will increase the utility infrastructure costs for mixed fuel homes, relative to all-electric homes, improving the cost-effectiveness of all-electric construction. The Reach Codes Team intends to quantify this impact in future studies.

Table 8 presents utility infrastructure costs for the detached ADU, both mixed fuel and all-electric designs. These costs are directly from the 2019 detached ADU reach code report (Statewide Reach Codes Team, 2021b) and were obtained from stakeholder interviews and RS Means. For the ADU scenario it's assumed that natural gas infrastructure already exists on the lot and is being extended to the location of the ADU typically at the back of the lot. There are incremental cost savings for an all-electric ADU from not extending the natural gas service; however, there is also a small incremental cost for upgrading the electric service to accommodate the additional electrical load. The Reach Codes Team found that a new detached ADU would require that the building owner upgrade the service connection to the lot in both the mixed fuel ADU design and the all-electric design. The most common size for this upgrade is to upsize the existing panel to 225A, which would not represent an incremental cost from the mixed fuel project to the all-electric project. Feeder wiring to the ADU and the ADU subpanel, on the other hand, will need to be slightly upgraded for the all-electric design.

**Table 8: ADU Utility Infrastructure Total and Incremental Costs**

| Mixed Fuel Measure                              | Mixed Fuel Total Cost | All-Electric Measure                            | All-Electric Total Cost | All-Electric Incremental Cost |
|---|-----------------------|---|-------------------------|-------------------------------|
| Site natural gas service extension              | \$1,998               | No site natural gas service                     | \$0                     | (\$1,998)                     |
| Site electrical service connection upgrade 225A | \$3,500               | Site electrical service connection upgrade 225A | \$3,500                 | \$0                           |
| 100A feeder to ADU with breaker                 | \$933                 | 125A feeder to ADU with breaker                 | \$1,206                 | \$273                         |
| 100A ADU subpanel                               | \$733                 | 125A ADU subpanel                               | \$946                   | \$213                         |
| <b>Totals</b>                                   | <b>\$7,164</b>        |   | <b>\$5,652</b>          | <b>(\$1,512)</b>              |

### 3.3.2.2 Equipment

This section provides descriptions and costs of the equipment applied to electrify mixed fuel homes in the all-electric packages. The equipment meets but does not exceed federal efficiency requirements to avoid federal preemption concerns.

<sup>16</sup> <https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-eliminates-last-remaining-utility-subsidies-for-new-construction-of-buildings-using-gas-2023>

For the water heating and space conditioning equipment analyzed, cost analyses incorporated the equipment's effective useful lifetime (EUL), which are summarized in Table 9. The EUL for the heat pump, furnace, and air conditioner are based on the Database for Energy Efficient Resources (DEER) (California Public Utilities Commission, 2021b). Water heating equipment lifetimes are based on DOE's recent water heater rulemaking (Department of Energy, 2022). Replacement costs are applied when equipment reaches its EUL within the 30-year evaluation period, and in such cases are included in the total lifetime costs. Residual value of the gas furnace and gas tankless at the end of the 30-year analysis period was accounted for to represent the remaining life of the equipment.

In this analysis, replacement costs assume a like-for-like replacement of equipment type and fuel (as listed in Table 9). However, this may be precluded in the future due to efforts to prohibit the sale of gas equipment currently being considered or undertaken by air districts (ex. BAAQMD, SCAQMD) and the California Air Resources Board (ex. zero NOx appliance rules).

**Table 9: Effective Useful Lifetime (EUL) of Water Heating & Space Conditioning Equipment**

| Measure                   | EUL (Years) |
|---------------------------|-------------|
| Gas Furnace               | 20          |
| Air Conditioner           | 15          |
| Heat Pump                 | 15          |
| Gas Tankless Water Heater | 20          |
| Heat Pump Water Heater    | 15          |

**Space Conditioning:** This measure covers replacing a prescriptive air conditioner and gas furnace with a minimum efficiency heat pump in applicable climate zones (1, 2, 5 to 12, 15 and 16; see Table 3). Typical incremental costs for this equipment were based on contractor feedback and price variation by system capacity from the AC Wholesalers website and the RS Means cost database (RSMeans, 2022). Costs were applied based on the system capacity from heating and cooling load calculations in CBECC-Res as presented in Table 10. 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, 5 to 12, and 15 were cooling-dominated while Climate Zones 1 and 16 were heating-dominated. In the heating dominated climate zones the heat pump for the single family home needs to be upsized relative to an air conditioner that only provides cooling.

Replacement costs were estimated based on a contractor survey conducted by the Statewide Reach Codes Team in 2023 (Statewide Reach Codes Team, tbd), less any gas and electric infrastructure costs, and the equipment lifetimes listed in Table 9. Resultant incremental costs are presented in Table 11.

This measure, and thus the incremental cost, does not apply to climate zones where heat pump space conditioning is already prescriptively required (Climate Zones 3, 4, 13, and 14).

**Table 10: Space Conditioning System Nominal Capacities**

| Climate Zone | Single Family                   |                           | ADU                             |                           |
|--------------|---------------------------------|---------------------------|---------------------------------|---------------------------|
|              | Air Conditioner Capacity (tons) | Heat Pump Capacity (tons) | Air Conditioner Capacity (tons) | Heat Pump Capacity (tons) |
| 1            | 1.5                             | 2.5                       | 1.5                             | 1.5                       |
| 2            | 3                               | 3                         | 1.5                             | 1.5                       |
| 3            | -                               | -                         | -                               | -                         |
| 4            | -                               | -                         | -                               | -                         |
| 5            | 3                               | 3                         | 1.5                             | 1.5                       |
| 6            | 3                               | 3                         | 1.5                             | 1.5                       |
| 7            | 3                               | 3                         | 1.5                             | 1.5                       |
| 8            | 2.5                             | 2.5                       | 1.5                             | 1.5                       |
| 9            | 2.5                             | 2.5                       | 1.5                             | 1.5                       |
| 10           | 2.5                             | 2.5                       | 1.5                             | 1.5                       |
| 11           | 3                               | 3                         | 1.5                             | 1.5                       |
| 12           | 2.5                             | 2.5                       | 1.5                             | 1.5                       |
| 13           | -                               | -                         | -                               | -                         |
| 14           | -                               | -                         | -                               | -                         |
| 15           | 4                               | 4                         | 1.5                             | 1.5                       |
| 16           | 2                               | 3.5                       | 1.5                             | 1.5                       |

**Table 11: Space Conditioning System Incremental Costs (2023 PV\$)**

| Climate Zone | Single Family |                                | ADU        |                                |
|--------------|---------------|--------------------------------|------------|--------------------------------|
|              | First Cost    | Total Lifetime Cost (Financed) | First Cost | Total Lifetime Cost (Financed) |
| 1            | \$803         | \$2,705                        | (\$2,120)  | (\$1,717)                      |
| 2            | (\$1,044)     | (\$44)                         | (\$2,120)  | (\$1,717)                      |
| 3            | -             | -                              | -          | -                              |
| 4            | -             | -                              | -          | -                              |
| 5            | (\$1,044)     | (\$44)                         | (\$2,120)  | (\$1,717)                      |
| 6            | (\$1,044)     | (\$44)                         | (\$2,120)  | (\$1,717)                      |
| 7            | (\$1,044)     | (\$44)                         | (\$2,120)  | (\$1,717)                      |
| 8            | (\$1,445)     | (\$673)                        | (\$2,120)  | (\$1,717)                      |
| 9            | (\$1,445)     | (\$673)                        | (\$2,120)  | (\$1,717)                      |
| 10           | (\$1,445)     | (\$673)                        | (\$2,120)  | (\$1,717)                      |
| 11           | (\$1,044)     | (\$44)                         | (\$2,120)  | (\$1,717)                      |
| 12           | (\$1,445)     | (\$673)                        | (\$2,120)  | (\$1,717)                      |
| 13           | -             | -                              | -          | -                              |
| 14           | -             | -                              | -          | -                              |
| 15           | (\$1,032)     | \$368                          | (\$2,120)  | (\$1,717)                      |
| 16           | \$2,331       | \$5,123                        | (\$2,120)  | (\$1,717)                      |

**Water Heater:** This measure covers replacing a prescriptive gas tankless water heater with a minimum efficiency HPWH in applicable climate zones (3, 4, 13, and 14; see Table 3). Typical incremental costs were based on costs from prior reach code work and recent contractor feedback. Incremental first costs assume a 65-gal HPWH and incremental replacement costs account for equipment lifetimes listed in Table 9. Replacement costs assume no change in cost from the first cost estimates before accounting for inflation, less any gas and electric infrastructure costs. For the ADU analysis the water heater is evaluated within the conditioned space with the supply air ducted from the outside and exhaust air ducted to the outside. A mechanical contractor provided a cost estimate of \$943 for ducting through the attic in an ADU where the water heater is in an interior room. This cost is included in the equipment and installation total for the ADU. Resultant incremental costs are presented in Table 12.

**Table 12: Heat Pump Water Heating System Incremental Costs (2023 PV\$)**

| Item                     | ADU            |                                | Single Family |                                |
|--------------------------|----------------|--------------------------------|---------------|--------------------------------|
|                          | First Cost     | Total Lifetime Cost (Financed) | First Cost    | Total Lifetime Cost (Financed) |
| Equipment & Installation | \$2,243        | \$3,930                        | \$1,300       | \$2,267                        |
| Electric Service Upgrade | \$43           | \$48                           | \$45          | \$51                           |
| In-House Gas Piping      | (\$580)        | (\$651)                        | (\$580)       | (\$651)                        |
| <b>Total</b>             | <b>\$1,706</b> | <b>\$3,327</b>                 | <b>\$765</b>  | <b>\$1,666</b>                 |

For this electrification analysis, a HPWH that just meets the federal minimum efficiency standards<sup>17</sup> 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 Northwest Energy Efficiency Alliance (NEEA) established its own rating system for high efficiency HPWHs<sup>18</sup> and maintains a database of qualified products. The lowest UEF currently reported in the database is 2.73. In fact, of the four rating tiers offered by NEEA, 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<sup>19</sup> and there are fewer than 10 integrated products certified as Tier 1 or Tier 2, all of which have UEFs greater than 3.0.<sup>20</sup>

NEEA Tier 3 water heaters were included in the high-efficiency measure packages (see Section 3.4).

**Clothes Dryer and Range:** After review of various sources, the Reach Codes Team concluded that the cost difference between gas and electric resistance equipment for clothes dryers and stoves is negligible and that the lifetimes of the two technologies are similar. Resultant incremental costs are presented in Table 13. Note that while induction stoves may be a more likely installation option in many homes, CBECC-Res does not currently differentiate between electric technologies for stoves and therefore they were not considered in this analysis. Relative to electric resistance, induction stoves use less energy and improve performance and user satisfaction, at an additional cost.

**Electric Service Upgrade (appliance-specific):** The 2022 Title 24 Code requires electric readiness for gas appliances; as a result, the incremental costs to provide electrical service for electric appliances are minimal. The incremental costs accounted for in this study — shown in Table 13 — are calculated as the cost to install 220V service for the electric appliances less the cost for the electric ready requirements and for installing 110V service for the

<sup>17</sup> The Department of Energy establishes minimum energy conservation standards for consumer products, as directed in the Energy Policy and Conservation Act. See <https://www.ecfr.gov/current/title-10/chapter-II/subchapter-D/part-430/subpart-C/section-430.32>.

<sup>18</sup> 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.

<sup>19</sup> <https://neea.org/success-stories/heat-pump-water-heaters>

<sup>20</sup> As of 3/8/2024: <https://neea.org/img/documents/residential-unitary-HPWH-qualified-products-list.pdf>

comparable gas appliance. Incremental costs are applied for the space conditioner, water heater, and cooking range. Based on builder surveys, it's assumed that in a typical mixed fuel home both electric and gas service are provided to the dryer location and therefore no incremental costs for the dryer were applied. Costs assume 50A service for the range and 30A service for the space conditioner and water heater. Costs are assumed to be the same for the single family and ADU analyses.

**In-House Natural Gas Infrastructure (from meter to appliances):** Installation cost to run a natural gas line from the meter to the appliance location was estimated at \$580 per appliance, as shown in Table 13. These costs were based on material costs from Home Depot and labor costs from 2022 RS Means. The material costs were about 1/3 higher in RS Means than Home Depot, so the Reach Codes Team used the lower costs from Home Depot. The Reach Codes Team conducted a pipe sizing analysis for the two single family and one ADU prototype homes to estimate the length and diameter of gas piping required assuming the home included a gas furnace, gas tankless water heater, gas range, and gas dryer. Total estimated costs were very similar for each of the three prototypes and an average cost per appliance of \$580 was determined. Costs are assumed to be the same for the single family and ADU analyses.

**Table 13: Single Family All-Electric Appliance Incremental Costs**

| Item  | ADU & Single Family |                                |
|---|---------------------|--------------------------------|
|   | First Cost          | Total Lifetime Cost (Financed) |
| <b><i>Electric Resistance vs Gas Cooking</i></b>        |                     |                                |
| Equipment & Installation                                | \$0                 | \$0                            |
| Electric Service Upgrade                                | \$100               | \$113                          |
| In-House Gas Piping                                     | (\$580)             | (\$651)                        |
| <b>Total</b>  | <b>(\$480)</b>      | <b>(\$539)</b>                 |
| <b><i>Electric Resistance vs Gas Clothes Drying</i></b> |                     |                                |
| Equipment & Installation                                | \$0                 | \$0                            |
| Electric Service Upgrade                                | \$0                 | \$0                            |
| In-House Gas Piping                                     | (\$580)             | (\$651)                        |
| <b>Total</b>  | <b>(\$580)</b>      | <b>(\$651)</b>                 |

### 3.4 Measure Packages

The Reach Codes Team evaluated two packages for mixed fuel homes and five packages for all-electric homes for each prototype and climate zone, as described below.

1. All-Electric Code Minimum: This package applied the prescriptive requirements of the 2022 Title 24 Code and replaced gas equipment with minimum efficiency electric equipment.
2. Efficiency Only, all-electric: This package used only efficiency measures that don't trigger federal preemption issues including envelope, water heating distribution, and duct distribution efficiency measures. For ADUs, this also included ductless variable capacity heat pumps (VCHPs). This package was evaluated for the all-electric homes only.
3. Efficiency + High Efficiency (Preempted) Equipment, all-electric and mixed fuel: This package builds off the Efficiency Only package, adding water heating and space conditioning equipment that is more efficient than federal standards. The Reach Codes Team considers this more reflective of how builders meet above code requirements in practice. This package was evaluated to compare compliance results against the other non-preempted packages (see Table 27 and Table 28), however cost-effectiveness was not evaluated for this package since it cannot serve as the basis for adoption of a local ordinance. Specifically, it applied:
  - a. Water heating, all-electric: Heat pump water heaters with a NEEA Tier 3 rating (3.45 UEF).
  - b. Water heating, mixed fuel: High efficiency (0.95 UEF) gas tankless.

- c. Space conditioning, single family: High efficiency (16 SEER2/8 HSPF2) heat pumps. In mixed fuel packages, for climate zones with prescriptive gas heating, high efficiency (16 SEER2/95 AFUE) units were applied.
- 4. Efficiency + PV, all-electric: This package also builds on the Efficiency Only package, excluding preempted equipment. Instead, PV capacity was added to offset all of the estimated annual electricity use. This package was evaluated for the all-electric homes only.
- 5. Efficiency + PV + Battery, all-electric and mixed fuel: Using the Efficiency + PV package as a starting point for the all-electric analysis, a battery system was added. For mixed fuel homes the package of efficiency measures differed from the all-electric homes in some climate zones to arrive at a cost-effective solution.

To reiterate previous statements, the non-preempted measures used in all of the above packages (except for the All-Electric Code Minimum package) are referred to as “Efficiency measures”. As noted above, these measures may differ by prototype (single family vs. ADU) and by package. See Table 40 and Table 41 for the details of these measures.

4 Results

Section 4.1 presents compliance results for all-electric versus mixed fuel code minimum packages to provide a broad overview of how these different approaches impact code compliance. Sections 4.2 to 4.5 present EDR results along with other savings data for packages of particular interest, as well as cost-effectiveness results for all packages. Section 4.5 presents results for sensitivity analyses. All results reflect savings over a 30-year analysis period and are compared against the 2022 prescriptive baseline.

4.1 Compliance Results: All-Electric vs. Mixed Fuel Code Minimum

The Reach Codes Team evaluated the compliance impacts of a prescriptive all-electric home as well as a traditional mixed fuel home with four gas appliances (space heating, water heating, cooking, clothes drying). Compliance is relative to the 2022 prescriptive base case home with three gas appliances which, by definition, has a compliance margin of zero in all climate zones. The impacts for the all-electric single family home and the ADU are presented in Figure 1 and Figure 2, respectively. The all-electric single family and ADU home prototypes are code compliant with both EDR1 (source energy) and efficiency EDR2 (TDV energy) in all climate zones, though the compliance margin is highly variable across climate zones. The four gas appliance single family home is presented in Figure 3. This case is not code compliant in any climate zone.

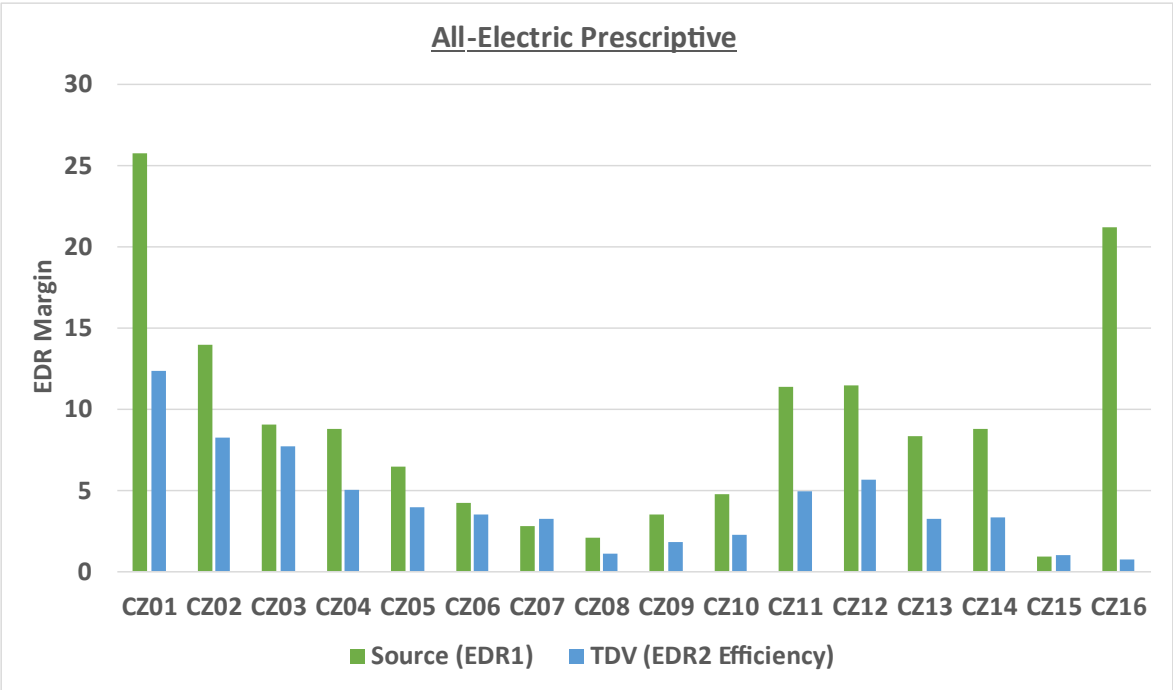


Figure 1: Single family all-electric home compliance impacts.

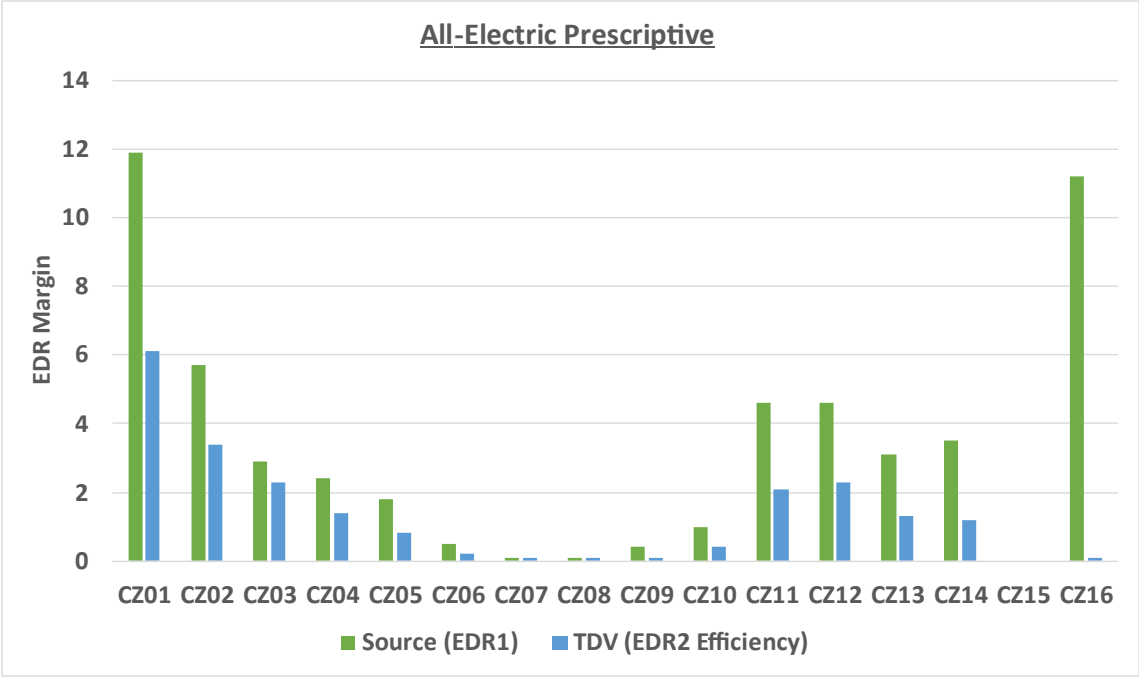


Figure 2: ADU all-electric home compliance impacts.

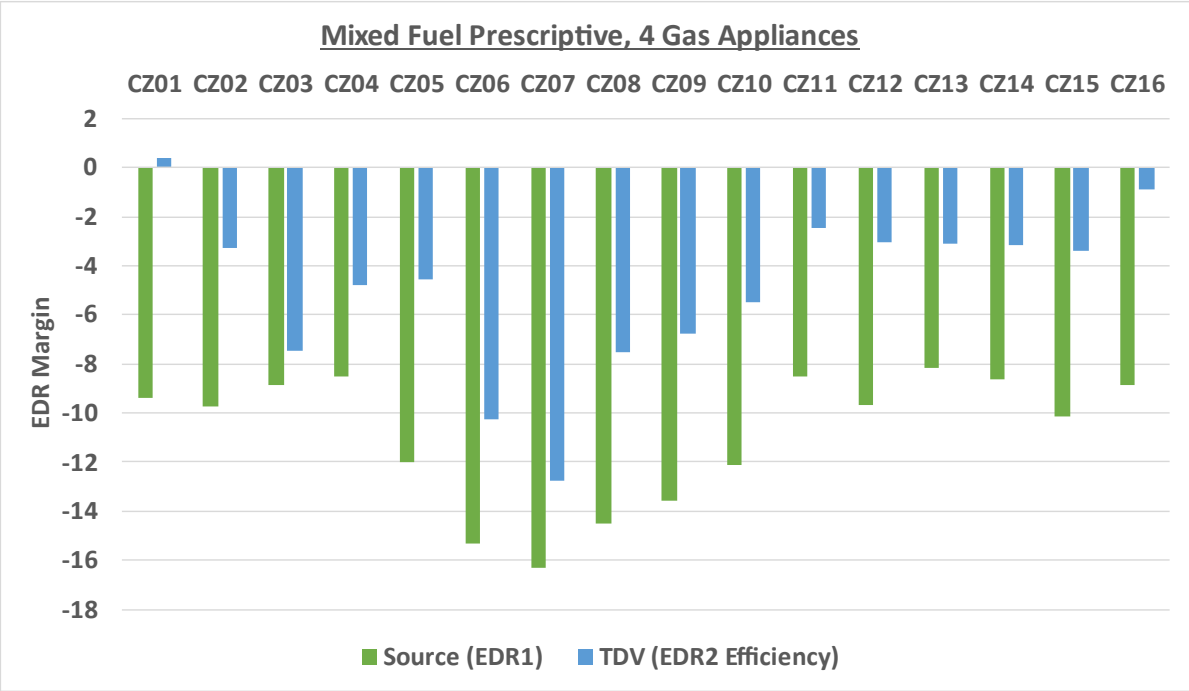


Figure 3: Single family four gas appliance home compliance impacts.

This analysis illustrates a couple of interesting points:

1. The 2022 compliance metrics are important drivers encouraging electrification. The compliance penalties associated with the four gas appliance home scenarios are significant and will require deep efficiency measures to overcome.
2. The 2022 Title 24 Code's new source energy metric combined with the heat pump baseline encourage all-electric construction, providing a compliance benefit that allows for some amount of prescriptively required building efficiency to be traded off and still comply when using the performance method.

## 4.2 All-Electric Code Minimum Results

Table 14 shows results for the single family all-electric Code Minimum measure package. Utility cost savings are negative, indicating an increase in utility costs for the all-electric building, everywhere except in CPAU and SMUD territories. In all cases the incremental cost is negative, which reflects cost savings for the all-electric building due to elimination of gas infrastructure costs. The package is cost-effective based on TDV in all cases but one (Climate Zone 16); it's not cost-effective On-Bill in Climate Zones 1, 3, 14, and 16.

Table 15 shows the all-electric Code Minimum package results for the ADU. Utility savings and incremental costs reflect the same general trend as single family homes. Cost-effectiveness is less favorable than the single family application, with TDV cost-effectiveness not met in Climate Zones 3, 4, 13, and 14, and On-Bill cost-effectiveness met only in Climate Zones 4 in CPAU territory, 10 in SCE/SCG territory, 12 in SMUD/PG&E territory, 11 and 15. Cost-effectiveness in Climate Zones 3, 4, 13, and 14 is worse than in the other climate zones due to the higher cost of converting from a gas tankless to a ducted HPWH (see Table 3) which isn't offset enough by the energy savings. Cost savings due to elimination of gas infrastructure costs are also lower for the ADU relative to the single family home.

Table 14: Single Family Cost-Effectiveness: All-Electric Code Minimum

| Climate Zone | Electric /Gas Utility | Total EDR1 Margin | Efficiency EDR2 Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost <sup>1</sup> |                    | On-Bill   |           | TDV       |           |
|--------------|-----------------------|-------------------|------------------------|---------------------------|-----------------------------|----------------------|--------------------|-------------------------------|--------------------|-----------|-----------|-----------|-----------|
|              |                       |                   |                        |                           |                             | First Year           | Lifecycle (2022\$) | First Year                    | Lifecycle (2022\$) | B/C Ratio | NPV       | B/C Ratio | NPV       |
| CZ01         | PGE                   | 25.8              | 12.4                   | -4,308                    | 398                         | (\$431)              | (\$3,873)          | (\$4,816)                     | (\$3,605)          | 0.9       | (\$268)   | >1        | \$5,702   |
| CZ02         | PGE                   | 14.0              | 8.3                    | -2,888                    | 246                         | (\$327)              | (\$4,000)          | (\$6,664)                     | (\$6,355)          | 1.6       | \$2,355   | >1        | \$7,711   |
| CZ03         | PGE                   | 9.1               | 7.7                    | -2,433                    | 171                         | (\$303)              | (\$4,734)          | (\$4,854)                     | (\$4,644)          | 0.98      | (\$90)    | 25.3      | \$3,887   |
| CZ04         | PGE                   | 8.8               | 5.0                    | -2,232                    | 163                         | (\$251)              | (\$3,665)          | (\$4,854)                     | (\$4,644)          | 1.3       | \$979     | >1        | \$4,494   |
| CZ04         | CPAU                  | 8.8               | 5.0                    | -2,232                    | 163                         | (\$36)               | \$2,123            | (\$8,122)                     | (\$8,314)          | >1        | \$10,437  | >1        | \$7,762   |
| CZ05         | PGE                   | 6.5               | 4.0                    | -1,960                    | 133                         | (\$292)              | (\$4,981)          | (\$6,664)                     | (\$6,355)          | 1.3       | \$1,373   | 6.1       | \$4,633   |
| CZ05         | PGE/SCG               | 6.5               | 4.0                    | -1,960                    | 133                         | (\$277)              | (\$4,532)          | (\$6,664)                     | (\$6,355)          | 1.4       | \$1,823   | 6.1       | \$4,633   |
| CZ06         | SCE/SCG               | 4.2               | 3.5                    | -1,432                    | 84                          | (\$231)              | (\$4,015)          | (\$6,664)                     | (\$6,355)          | 1.6       | \$2,339   | 4.7       | \$4,353   |
| CZ07         | SDGE                  | 2.8               | 3.2                    | -1,293                    | 69                          | (\$266)              | (\$5,731)          | (\$6,664)                     | (\$6,355)          | 1.1       | \$624     | 4.2       | \$4,211   |
| CZ08         | SCE/SCG               | 2.1               | 1.1                    | -1,293                    | 67                          | (\$228)              | (\$4,192)          | (\$7,065)                     | (\$6,983)          | 1.7       | \$2,792   | 4.2       | \$4,674   |
| CZ09         | SCE                   | 3.6               | 1.9                    | -1,453                    | 84                          | (\$237)              | (\$4,153)          | (\$7,065)                     | (\$6,983)          | 1.7       | \$2,831   | 5.5       | \$5,013   |
| CZ10         | SCE/SCG               | 4.8               | 2.3                    | -1,683                    | 107                         | (\$258)              | (\$4,342)          | (\$7,065)                     | (\$6,983)          | 1.6       | \$2,642   | 7.4       | \$5,287   |
| CZ10         | SDGE                  | 4.8               | 2.3                    | -1,683                    | 107                         | (\$265)              | (\$5,158)          | (\$7,065)                     | (\$6,983)          | 1.4       | \$1,825   | 7.4       | \$5,287   |
| CZ11         | PGE                   | 11.4              | 4.9                    | -2,712                    | 226                         | (\$306)              | (\$3,803)          | (\$6,664)                     | (\$6,355)          | 1.7       | \$2,552   | >1        | \$7,153   |
| CZ12         | PGE                   | 11.5              | 5.6                    | -2,554                    | 212                         | (\$294)              | (\$3,773)          | (\$7,065)                     | (\$6,983)          | 1.9       | \$3,210   | >1        | \$7,504   |
| CZ12         | SMUD/PGE              | 11.5              | 5.6                    | -2,554                    | 212                         | \$79                 | \$4,731            | (\$7,065)                     | (\$6,983)          | >1        | \$11,714  | >1        | \$7,504   |
| CZ13         | PGE                   | 8.3               | 3.2                    | -2,095                    | 154                         | (\$224)              | (\$3,164)          | (\$4,854)                     | (\$4,644)          | 1.5       | \$1,480   | >1        | \$4,490   |
| CZ14         | SCE/SCG               | 8.8               | 3.3                    | -2,291                    | 159                         | (\$322)              | (\$5,166)          | (\$4,854)                     | (\$4,644)          | 0.9       | (\$522)   | >1        | \$4,105   |
| CZ14         | SDGE                  | 8.8               | 3.3                    | -2,291                    | 159                         | (\$344)              | (\$6,361)          | (\$4,854)                     | (\$4,644)          | 0.7       | (\$1,717) | >1        | \$4,105   |
| CZ15         | SCE/SCG               | 0.9               | 1.0                    | -1,167                    | 53                          | (\$217)              | (\$4,152)          | (\$6,652)                     | (\$5,942)          | 1.4       | \$1,791   | 3.0       | \$3,439   |
| CZ16         | PG&E                  | 21.3              | 0.7                    | -4,729                    | 403                         | (\$548)              | (\$6,581)          | (\$3,289)                     | (\$1,187)          | 0.2       | (\$5,394) | 0.4       | (\$1,339) |

<sup>1</sup> Though uncommon, incremental costs can be negative, reflecting initial construction cost savings. When paired with increased energy costs (negative benefits), the construction cost savings are treated as the 'benefit' while the increased energy costs are the 'cost,' which may yield positive cost effectiveness. See Section 2.1.2.3 for more information.

Table 15: ADU Cost-Effectiveness: All-Electric Code Minimum

| Climate Zone | Electric /Gas Utility | Total EDR1 Margin | Efficiency EDR2 Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost <sup>1</sup> |                    | On-Bill   |            | TDV       |           |
|--------------|-----------------------|-------------------|------------------------|---------------------------|-----------------------------|----------------------|--------------------|-------------------------------|--------------------|-----------|------------|-----------|-----------|
|              |                       |                   |                        |                           |                             | First Year           | Lifecycle (2022\$) | First Year                    | Lifecycle (2022\$) | B/C Ratio | NPV        | B/C Ratio | NPV       |
| CZ01         | PGE                   | 11.9              | 6.1                    | -1,641                    | 114                         | (\$353)              | (\$6,682)          | (\$4,692)                     | (\$4,605)          | 0.7       | (\$2,077)  | 3.9       | \$2,986   |
| CZ02         | PGE                   | 5.7               | 3.4                    | -1,245                    | 75                          | (\$312)              | (\$6,347)          | (\$4,692)                     | (\$4,605)          | 0.7       | (\$1,742)  | 2.7       | \$2,515   |
| CZ03         | PGE                   | 2.9               | 2.3                    | -1,672                    | 123                         | (\$377)              | (\$7,138)          | (\$863)                       | \$442              | 0.0       | (\$7,581)  | 0.0       | (\$1,489) |
| CZ04         | PGE                   | 2.4               | 1.4                    | -1,612                    | 118                         | (\$366)              | (\$6,964)          | (\$863)                       | \$442              | 0.0       | (\$7,406)  | 0.0       | (\$801)   |
| CZ04         | CPAU                  | 2.4               | 1.4                    | -1,612                    | 118                         | \$25                 | \$3,035            | (\$863)                       | \$442              | 6.9       | \$2,592    | 0.0       | (\$801)   |
| CZ05         | PGE                   | 1.8               | 0.8                    | -1,026                    | 49                          | (\$302)              | (\$6,517)          | (\$4,692)                     | (\$4,605)          | 0.7       | (\$1,912)  | 2.0       | \$2,021   |
| CZ05         | PGE/SCG               | 1.8               | 0.8                    | -1,026                    | 49                          | (\$257)              | (\$5,178)          | (\$4,692)                     | (\$4,605)          | 0.9       | (\$574)    | 2.0       | \$2,021   |
| CZ06         | SCE/SCG               | 0.5               | 0.2                    | -904                      | 38                          | (\$243)              | (\$4,923)          | (\$4,692)                     | (\$4,605)          | 0.9       | (\$318)    | 2.1       | \$2,135   |
| CZ07         | SDGE                  | 0.1               | 0.1                    | -884                      | 37                          | (\$337)              | (\$7,903)          | (\$4,692)                     | (\$4,605)          | 0.6       | (\$3,298)  | 2.2       | \$2,205   |
| CZ08         | SCE/SCG               | 0.1               | 0.1                    | -878                      | 36                          | (\$241)              | (\$4,894)          | (\$4,692)                     | (\$4,605)          | 0.9       | (\$289)    | 2.3       | \$2,274   |
| CZ09         | SCE                   | 0.4               | 0.1                    | -903                      | 38                          | (\$243)              | (\$4,914)          | (\$4,692)                     | (\$4,605)          | 0.9       | (\$310)    | 2.4       | \$2,321   |
| CZ10         | SCE/SCG               | 1.0               | 0.4                    | -952                      | 43                          | (\$189)              | (\$3,629)          | (\$4,692)                     | (\$4,605)          | 1.3       | \$976      | 2.8       | \$2,577   |
| CZ10         | SDGE                  | 1.0               | 0.4                    | -952                      | 43                          | (\$249)              | (\$5,689)          | (\$4,692)                     | (\$4,605)          | 0.8       | (\$1,084)  | 2.8       | \$2,577   |
| CZ11         | PGE                   | 4.6               | 2.1                    | -1,209                    | 71                          | (\$224)              | (\$4,405)          | (\$4,692)                     | (\$4,605)          | 1.0       | \$200      | 3.5       | \$2,870   |
| CZ12         | PGE                   | 4.6               | 2.3                    | -1,183                    | 69                          | (\$306)              | (\$6,315)          | (\$4,692)                     | (\$4,605)          | 0.7       | (\$1,710)  | 3.0       | \$2,684   |
| CZ12         | SMUD/PGE              | 4.6               | 2.3                    | -1,183                    | 69                          | (\$65)               | (\$808)            | (\$4,692)                     | (\$4,605)          | 5.7       | \$3,797    | 3.0       | \$2,684   |
| CZ13         | PGE                   | 3.1               | 1.3                    | -1,611                    | 112                         | (\$218)              | (\$3,689)          | (\$863)                       | \$442              | 0.0       | (\$4,131)  | 0.0       | (\$858)   |
| CZ14         | SCE/SCG               | 3.5               | 1.2                    | -1,714                    | 115                         | (\$375)              | (\$6,933)          | (\$863)                       | \$442              | 0.0       | (\$7,375)  | 0.0       | (\$1,089) |
| CZ14         | SDGE                  | 3.5               | 1.2                    | -1,714                    | 115                         | (\$483)              | (\$10,348)         | (\$863)                       | \$442              | 0.0       | (\$10,790) | 0.0       | (\$1,089) |
| CZ15         | SCE/SCG               | 0.0               | 0.0                    | -864                      | 36                          | (\$172)              | (\$3,359)          | (\$4,692)                     | (\$4,605)          | 1.4       | \$1,246    | 2.6       | \$2,477   |
| CZ16         | PG&E                  | 11.2              | 0.1                    | -1,781                    | 122                         | (\$379)              | (\$7,167)          | (\$4,692)                     | (\$4,605)          | 0.6       | (\$2,562)  | 2.1       | \$2,133   |

<sup>1</sup> Though uncommon, incremental costs can be negative, reflecting initial construction cost savings. When paired with increased energy costs (negative benefits), the construction cost savings are treated as the 'benefit' while the increased energy costs are the 'cost,' which may yield positive cost effectiveness. See Section 2.1.2.3 for more information.

### 4.3 All-Electric Efficiency, PV, and Battery Results

Table 16 and Table 17 compare cost-effectiveness results for the all-electric packages for the single family and ADU prototypes, respectively, with the exception of the all-electric Efficiency + High Efficiency (Preempted) Equipment package (cost-effectiveness was not evaluated for this package but see Table 27 and Table 28 for a comparison of compliance impacts). In almost all cases the packages are cost-effective based on TDV. On-Bill cost-effectiveness generally improves with the addition of efficiency measures, further improves with an upsized PV system, and improves even more once batteries are added. A summary of measures included in each package is provided in Appendix 7.3 Summary of Measures by Package. The efficiency measures added to the all-electric package to meet minimum code requirements are described in Table 39 and Table 41.

**Table 16: Single Family Cost-Effectiveness: Comparison of All-Electric Efficiency Only, PV, and Battery Packages**

| Climate Zone | Electric /Gas Utility | All-Electric Code Minimum |           |           |           | All-Electric Efficiency Only |           |           |         | All-Electric-Efficiency + PV |           |           |          | All-Electric Efficiency + PV + Battery |           |           |         |
|--------------|-----------------------|---------------------------|-----------|-----------|-----------|------------------------------|-----------|-----------|---------|------------------------------|-----------|-----------|----------|--|-----------|-----------|---------|
|              |                       | On-Bill                   |           | TDV       |           | On-Bill                      |           | TDV       |         | On-Bill                      |           | TDV       |          | On-Bill                                |           | TDV       |         |
|              |                       | B/C Ratio                 | NPV       | B/C Ratio | NPV       | B/C Ratio                    | NPV       | B/C Ratio | NPV     | B/C Ratio                    | NPV       | B/C Ratio | NPV      | B/C Ratio                              | NPV       | B/C Ratio | NPV     |
| CZ01         | PGE                   | 0.9                       | (\$268)   | >1        | \$5,702   | >1                           | \$2,945   | >1        | \$8,168 | 0.9                          | (\$1,313) | 1.8       | \$9,817  | 1.0                                    | \$1,012   | 1.2       | \$4,391 |
| CZ02         | PGE                   | 1.6                       | \$2,355   | >1        | \$7,711   | 8.9                          | \$3,870   | >1        | \$9,325 | 1.5                          | \$2,242   | 4.2       | \$12,452 | 1.3                                    | \$4,962   | 1.5       | \$8,190 |
| CZ03         | PGE                   | 1.0                       | (\$90)    | 25.3      | \$3,887   | 1.1                          | \$168     | >1        | \$3,939 | 0.8                          | (\$903)   | 2.8       | \$6,465  | 1.1                                    | \$2,114   | 1.1       | \$1,347 |
| CZ04         | PGE                   | 1.3                       | \$979     | >1        | \$4,494   | 1.7                          | \$1,054   | >1        | \$4,849 | 1.1                          | \$204     | 3.5       | \$7,893  | 1.2                                    | \$3,709   | 1.3       | \$4,506 |
| CZ04         | CPAU                  | >1                        | \$10,437  | >1        | \$7,762   | >1                           | \$10,021  | >1        | \$8,117 | >1                           | \$14,776  | >1        | \$11,161 | 0.9                                    | (\$1,076) | 1.5       | \$6,724 |
| CZ05         | PGE                   | 1.3                       | \$1,373   | 6.1       | \$4,633   | 1.6                          | \$1,975   | >1        | \$4,985 | 2.2                          | \$1,457   | 8.5       | \$7,927  | 1.4                                    | \$6,203   | 1.3       | \$3,876 |
| CZ05         | PGE/SCG               | 1.4                       | \$1,823   | 6.1       | \$4,633   | 1.9                          | \$2,424   | >1        | \$4,985 | 2.6                          | \$1,907   | 8.5       | \$7,927  | 1.4                                    | \$6,652   | 1.3       | \$3,876 |
| CZ06         | SCE/SCG               | 1.6                       | \$2,339   | 4.7       | \$4,353   | 1.6                          | \$1,813   | >1        | \$4,119 | 109.5                        | \$2,638   | 152.4     | \$6,727  | 1.5                                    | \$7,153   | 1.2       | \$2,276 |
| CZ07         | SDGE                  | 1.1                       | \$624     | 4.2       | \$4,211   | 1.2                          | \$839     | 8.3       | \$4,070 | 5.7                          | \$469     | >1        | \$6,079  | 2.0                                    | \$13,798  | 1.1       | \$1,186 |
| CZ08         | SCE/SCG               | 1.7                       | \$2,792   | 4.2       | \$4,674   | 1.8                          | \$2,574   | 17.7      | \$4,642 | >1                           | \$3,329   | >1        | \$7,492  | 1.7                                    | \$8,899   | 1.2       | \$2,085 |
| CZ09         | SCE                   | 1.7                       | \$2,831   | 5.5       | \$5,013   | 1.9                          | \$2,699   | >1        | \$5,087 | >1                           | \$3,634   | >1        | \$8,007  | 1.7                                    | \$9,151   | 1.3       | \$3,630 |
| CZ10         | SCE/SCG               | 1.6                       | \$2,642   | 7.4       | \$5,287   | 2.0                          | \$2,668   | >1        | \$5,376 | >1                           | \$3,765   | >1        | \$8,347  | 1.7                                    | \$10,088  | 1.3       | \$3,901 |
| CZ10         | SDGE                  | 1.4                       | \$1,825   | 7.4       | \$5,287   | 1.8                          | \$2,438   | >1        | \$5,376 | >1                           | \$2,539   | >1        | \$8,347  | 2.4                                    | \$19,463  | 1.3       | \$3,901 |
| CZ11         | PGE                   | 1.7                       | \$2,552   | >1        | \$7,153   | >1                           | \$4,159   | >1        | \$8,524 | 1.8                          | \$2,984   | 4.6       | \$11,310 | 1.4                                    | \$7,781   | 1.5       | \$8,757 |
| CZ12         | PGE                   | 1.9                       | \$3,210   | >1        | \$7,504   | 4.6                          | \$3,742   | >1        | \$8,084 | 1.9                          | \$2,561   | 5.5       | \$11,063 | 1.3                                    | \$6,021   | 1.5       | \$8,216 |
| CZ12         | SMUD/PGE              | >1                        | \$11,714  | >1        | \$7,504   | >1                           | \$10,665  | >1        | \$8,084 | 5.8                          | \$13,407  | 5.5       | \$11,063 | 0.9                                    | (\$1,237) | 1.4       | \$7,166 |
| CZ13         | PGE                   | 1.5                       | \$1,480   | >1        | \$4,490   | >1                           | \$2,876   | >1        | \$5,773 | 1.7                          | \$2,334   | 3.7       | \$8,341  | 1.4                                    | \$7,848   | 1.4       | \$7,005 |
| CZ14         | SCE/SCG               | 0.9                       | (\$522)   | >1        | \$4,105   | 1.8                          | \$811     | >1        | \$5,461 | 1.6                          | \$2,558   | 3.6       | \$9,965  | 1.6                                    | \$10,569  | 1.4       | \$6,204 |
| CZ14         | SDGE                  | 0.7                       | (\$1,717) | >1        | \$4,105   | 1.5                          | \$643     | >1        | \$5,461 | 1.2                          | \$922     | 3.6       | \$9,965  | 2.1                                    | \$20,099  | 1.4       | \$6,204 |
| CZ15         | SCE/SCG               | 1.4                       | \$1,791   | 3.0       | \$3,439   | 8.0                          | \$3,267   | >1        | \$4,669 | >1                           | \$3,940   | >1        | \$6,120  | 2.0                                    | \$13,576  | 0.99      | (\$80)  |
| CZ16         | PG&E                  | 0.2                       | (\$5,394) | 0.4       | (\$1,339) | 0.2                          | (\$1,946) | 1.7       | \$1,894 | 0.8                          | (\$3,199) | 1.6       | \$6,711  | 1.0                                    | \$206     | 1.1       | \$1,690 |

Table 17: ADU Cost-Effectiveness: All-Electric Energy Efficiency + Additional PV + Battery

| Climate Zone | Electric /Gas Utility | All-Electric Code Minimum |            |           |           | All-Electric Efficiency Only |            |           |           | All-Electric Efficiency + PV |           |           |         | All-Electric Efficiency + PV + Battery |           |           |         |
|--------------|-----------------------|---------------------------|------------|-----------|-----------|------------------------------|------------|-----------|-----------|------------------------------|-----------|-----------|---------|--|-----------|-----------|---------|
|              |                       | On-Bill                   |            | TDV       |           | On-Bill                      |            | TDV       |           | On-Bill                      |           | TDV       |         | On-Bill                                |           | TDV       |         |
|              |                       | B/C Ratio                 | NPV        | B/C Ratio | NPV       | B/C Ratio                    | NPV        | B/C Ratio | NPV       | B/C Ratio                    | NPV       | B/C Ratio | NPV     | B/C Ratio                              | NPV       | B/C Ratio | NPV     |
| CZ01         | PGE                   | 0.7                       | (\$2,077)  | 3.9       | \$2,986   | 0.7                          | (\$1,341)  | >1        | \$3,243   | 1.2                          | \$2,389   | 1.5       | \$5,353 | 1.0                                    | (\$216)   | 1.0       | (\$366) |
| CZ02         | PGE                   | 0.7                       | (\$1,742)  | 2.7       | \$2,515   | 0.5                          | (\$2,155)  | >1        | \$2,289   | 1.5                          | \$3,918   | 1.9       | \$6,704 | 1.1                                    | \$2,456   | 1.3       | \$5,648 |
| CZ03         | PGE                   | 0.0                       | (\$7,581)  | 0.0       | (\$1,489) | 0.0                          | (\$8,481)  | 0.0       | (\$2,235) | 0.83                         | (\$1,988) | 1.2       | \$1,882 | 0.86                                   | (\$3,653) | 1.0       | (\$492) |
| CZ04         | PGE                   | 0.0                       | (\$7,406)  | 0.0       | (\$801)   | 0.0                          | (\$8,319)  | 0.4       | (\$1,419) | 0.9                          | (\$1,094) | 1.4       | \$3,933 | 0.9                                    | (\$2,801) | 1.1       | \$1,875 |
| CZ04         | CPAU                  | 6.9                       | \$2,592    | 0.0       | (\$801)   | 1.5                          | \$1,330    | 0.4       | (\$1,419) | 1.7                          | \$8,884   | 1.4       | \$3,933 | 0.7                                    | (\$8,335) | 1.0       | \$825   |
| CZ05         | PGE                   | 0.7                       | (\$1,912)  | 2.0       | \$2,021   | 0.5                          | (\$2,810)  | 1.7       | \$1,095   | 1.7                          | \$4,515   | 2.1       | \$5,881 | 1.2                                    | \$3,324   | 1.1       | \$2,563 |
| CZ05         | PGE/SCG               | 0.9                       | (\$574)    | 2.0       | \$2,021   | 0.7                          | (\$1,472)  | 1.7       | \$1,095   | 2.0                          | \$5,853   | 2.1       | \$5,881 | 1.2                                    | \$4,662   | 1.1       | \$2,563 |
| CZ06         | SCE/SCG               | 0.9                       | (\$318)    | 2.1       | \$2,135   | 0.7                          | (\$1,078)  | 2.5       | \$1,548   | 2.1                          | \$6,366   | 2.4       | \$6,996 | 1.2                                    | \$3,195   | 1.3       | \$4,863 |
| CZ07         | SDGE                  | 0.6                       | (\$3,298)  | 2.2       | \$2,205   | 0.4                          | (\$4,038)  | 2.2       | \$1,386   | 2.0                          | \$6,167   | 2.1       | \$5,939 | 1.5                                    | \$11,261  | 1.1       | \$2,674 |
| CZ08         | SCE/SCG               | 0.9                       | (\$289)    | 2.3       | \$2,274   | 0.7                          | (\$1,046)  | 2.5       | \$1,523   | 2.1                          | \$6,750   | 2.5       | \$8,280 | 1.2                                    | \$4,320   | 1.4       | \$6,678 |
| CZ09         | SCE                   | 0.9                       | (\$310)    | 2.4       | \$2,321   | 0.7                          | (\$1,108)  | 2.7       | \$1,624   | 2.2                          | \$6,954   | 2.5       | \$8,052 | 1.2                                    | \$4,600   | 1.4       | \$8,273 |
| CZ10         | SCE/SCG               | 1.3                       | \$976      | 2.8       | \$2,577   | 1.1                          | \$280      | 4.3       | \$1,936   | 5.7                          | \$1,120   | 15.1      | \$3,840 | 1.0                                    | (\$593)   | 1.1       | \$940   |
| CZ10         | SDGE                  | 0.8                       | (\$1,084)  | 2.8       | \$2,577   | 0.7                          | (\$1,401)  | 4.3       | \$1,936   | 0.0                          | (\$1,079) | 15.1      | \$3,840 | 1.4                                    | \$6,523   | 1.1       | \$940   |
| CZ11         | PGE                   | 1.0                       | \$200      | 3.5       | \$2,870   | 1.1                          | \$290      | >1        | \$2,875   | 0.9                          | (\$216)   | 3.9       | \$4,381 | 1.0                                    | (\$600)   | 1.2       | \$2,983 |
| CZ12         | PGE                   | 0.7                       | (\$1,710)  | 3.0       | \$2,684   | 0.5                          | (\$2,152)  | >1        | \$2,222   | 1.6                          | \$5,030   | 2.0       | \$7,018 | 1.2                                    | \$3,451   | 1.3       | \$5,859 |
| CZ12         | SMUD/PGE              | 5.7                       | \$3,797    | 3.0       | \$2,684   | 15.3                         | \$2,366    | >1        | \$2,222   | 1.8                          | \$6,123   | 2.0       | \$7,018 | 0.6                                    | (\$8,899) | 1.2       | \$4,809 |
| CZ13         | PGE                   | 0.0                       | (\$4,131)  | 0.0       | (\$858)   | 0.0                          | (\$4,116)  | 0.6       | (\$879)   | 0.3                          | (\$4,374) | 1.1       | \$649   | 0.8                                    | (\$3,872) | 1.0       | \$456   |
| CZ14         | SCE/SCG               | 0.0                       | (\$7,375)  | 0.0       | (\$1,089) | 0.0                          | (\$7,543)  | 0.5       | (\$1,340) | 1.2                          | \$1,941   | 1.6       | \$6,279 | 1.1                                    | \$1,496   | 1.2       | \$4,644 |
| CZ14         | SDGE                  | 0.0                       | (\$10,790) | 0.0       | (\$1,089) | 0.0                          | (\$10,889) | 0.5       | (\$1,340) | 1.3                          | \$3,342   | 1.6       | \$6,279 | 1.4                                    | \$11,396  | 1.2       | \$4,644 |
| CZ15         | SCE/SCG               | 1.4                       | \$1,246    | 2.6       | \$2,477   | 2.8                          | \$1,629    | >1        | \$2,686   | >1                           | \$2,115   | >1        | \$3,904 | 1.2                                    | \$2,922   | 1.2       | \$2,135 |
| CZ16         | PG&E                  | 0.6                       | (\$2,562)  | 2.1       | \$2,133   | 0.6                          | (\$1,707)  | >1        | \$2,879   | 1.7                          | \$5,819   | 2.1       | \$8,219 | 1.2                                    | \$4,345   | 1.3       | \$6,454 |

#### 4.4 Mixed Fuel Results

Table 18 and Table 19 show results for the mixed fuel Efficiency + PV + Battery package for Single Family and ADU prototypes, respectively. On a TDV basis, this package is cost-effective only in Climate Zone 1 for single family and in no cases for ADUs. However, this package is cost-effective On-Bill for the single family home in all climate zones except 4 in CPAU territory and 12 in SMUD/PG&E territory. On-Bill cost-effectiveness for the ADU home, on the other hand, is seen only in Climate Zones 2, 5, 7 through 9, 10 in SDG&E territory, 14, and 16.

**Table 18: Single Family Cost-Effectiveness: Mixed Fuel Efficiency + PV + Battery**

| Climate Zone | Electric /Gas Utility | Total EDR1 Margin | Efficiency EDR2 Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |            | TDV       |           |
|--------------|-----------------------|-------------------|------------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|------------|-----------|-----------|
|              |                       |                   |                        |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV        | B/C Ratio | NPV       |
| CZ01         | PGE                   | 22.6              | 18.8                   | 1,571                     | 116                         | \$1,084              | \$26,667           | \$11,160         | \$20,166           | 1.3       | \$6,501    | 1.0       | \$500     |
| CZ02         | PGE                   | 14.1              | 7.4                    | 1,257                     | 34                          | \$913                | \$21,353           | \$10,268         | \$18,868           | 1.1       | \$2,486    | 0.9       | (\$1,282) |
| CZ03         | PGE                   | 12.8              | 4.3                    | 858                       | 7                           | \$785                | \$18,003           | \$8,708          | \$16,900           | 1.1       | \$1,104    | 0.7       | (\$4,777) |
| CZ04         | PGE                   | 13.2              | 4.3                    | 790                       | 6                           | \$803                | \$18,394           | \$9,623          | \$17,938           | 1.0       | \$456      | 0.8       | (\$3,925) |
| CZ04         | CPAU                  | 13.2              | 4.3                    | 790                       | 6                           | \$123                | \$2,877            | \$10,673         | \$19,172           | 0.2       | (\$16,295) | 0.7       | (\$4,975) |
| CZ05         | PGE                   | 14.8              | 4.9                    | 1,178                     | 13                          | \$905                | \$20,821           | \$10,021         | \$18,536           | 1.1       | \$2,285    | 0.8       | (\$4,048) |
| CZ05         | PGE/SCG               | 14.8              | 4.9                    | 1,178                     | 13                          | \$900                | \$20,690           | \$10,021         | \$18,536           | 1.1       | \$2,154    | 0.8       | (\$4,048) |
| CZ06         | SCE/SCG               | 18.3              | 5.5                    | 888                       | 6                           | \$864                | \$19,539           | \$9,266          | \$17,587           | 1.1       | \$1,951    | 0.8       | (\$3,941) |
| CZ07         | SDGE                  | 18.7              | 4.8                    | 832                       | 4                           | \$1,134              | \$27,505           | \$9,302          | \$17,636           | 1.6       | \$9,869    | 0.7       | (\$4,905) |
| CZ08         | SCE/SCG               | 17.1              | 3.0                    | 777                       | 2                           | \$920                | \$20,754           | \$9,134          | \$17,410           | 1.2       | \$3,344    | 0.7       | (\$4,341) |
| CZ09         | SCE                   | 16.2              | 3.1                    | 833                       | 3                           | \$922                | \$20,804           | \$9,152          | \$17,435           | 1.2       | \$3,369    | 0.8       | (\$3,839) |
| CZ10         | SCE/SCG               | 14.4              | 2.7                    | 846                       | 2                           | \$958                | \$21,608           | \$8,828          | \$17,062           | 1.3       | \$4,546    | 0.7       | (\$4,146) |
| CZ10         | SDGE                  | 14.4              | 2.7                    | 846                       | 2                           | \$1,288              | \$31,210           | \$8,828          | \$17,062           | 1.8       | \$14,148   | 0.7       | (\$4,146) |
| CZ11         | PGE                   | 12.9              | 5.1                    | 1,025                     | 26                          | \$1,031              | \$23,949           | \$9,099          | \$17,426           | 1.4       | \$6,523    | 0.98      | (\$285)   |
| CZ12         | PGE                   | 13.2              | 4.8                    | 1,098                     | 23                          | \$923                | \$21,415           | \$9,485          | \$17,964           | 1.2       | \$3,451    | 0.96      | (\$614)   |
| CZ12         | SMUD/PGE              | 13.2              | 4.8                    | 1,098                     | 23                          | \$253                | \$6,133            | \$10,535         | \$19,199           | 0.3       | (\$13,066) | 0.9       | (\$1,664) |
| CZ13         | PGE                   | 12.3              | 4.2                    | 1,006                     | 5                           | \$1,016              | \$23,250           | \$9,251          | \$17,585           | 1.3       | \$5,665    | 0.9       | (\$1,774) |
| CZ14         | SCE/SCG               | 13.4              | 5.4                    | 1,514                     | 6                           | \$1,093              | \$24,697           | \$10,214         | \$18,751           | 1.3       | \$5,945    | 0.9       | (\$1,383) |
| CZ14         | SDGE                  | 13.4              | 5.4                    | 1,514                     | 6                           | \$1,421              | \$34,477           | \$10,214         | \$18,751           | 1.8       | \$15,726   | 0.9       | (\$1,383) |
| CZ15         | SCE/SCG               | 13.5              | 3.8                    | 531                       | 2                           | \$1,140              | \$25,708           | \$8,586          | \$16,630           | 1.5       | \$9,078    | 0.6       | (\$5,490) |
| CZ16         | PG&E                  | 20.4              | 14.2                   | 1,228                     | 114                         | \$1,070              | \$26,218           | \$12,086         | \$20,964           | 1.3       | \$5,254    | 0.98      | (\$444)   |

**Table 19: ADU Cost-Effectiveness: Mixed Fuel Efficiency + PV + Battery**

| Climate Zone | Electric /Gas Utility | Total EDR1 Margin | Efficiency EDR2 Margin | Annual Elec Savings (kWh) | Annual Gas Savings (therms) | Utility Cost Savings |                    | Incremental Cost |                    | On-Bill   |            | TDV       |           |
|--------------|-----------------------|-------------------|------------------------|---------------------------|-----------------------------|----------------------|--------------------|------------------|--------------------|-----------|------------|-----------|-----------|
|              |                       |                   |                        |                           |                             | First Year           | Lifecycle (2022\$) | First Year       | Lifecycle (2022\$) | B/C Ratio | NPV        | B/C Ratio | NPV       |
| CZ01         | PGE                   | 18.5              | 7.7                    | 3,666                     | 20                          | \$1,078              | \$24,880           | \$15,088         | \$25,533           | 1.0       | (\$654)    | 0.7       | (\$6,375) |
| CZ02         | PGE                   | 16.6              | 3.5                    | 3,472                     | 11                          | \$1,042              | \$23,928           | \$13,502         | \$23,404           | 1.0       | \$524      | 0.8       | (\$3,785) |
| CZ03         | PGE                   | 11.8              | 1.2                    | 2,679                     | 0                           | \$781                | \$17,816           | \$11,433         | \$20,715           | 0.9       | (\$2,899)  | 0.7       | (\$6,381) |
| CZ04         | PGE                   | 13.3              | 1.6                    | 2,799                     | 0                           | \$859                | \$19,588           | \$11,869         | \$21,212           | 0.9       | (\$1,625)  | 0.7       | (\$4,962) |
| CZ04         | CPAU                  | 13.3              | 1.6                    | 2,799                     | 0                           | \$391                | \$8,911            | \$12,919         | \$22,447           | 0.4       | (\$13,536) | 0.7       | (\$6,012) |
| CZ05         | PGE                   | 16.9              | 1.1                    | 3,309                     | 2                           | \$1,031              | \$23,539           | \$12,222         | \$21,774           | 1.1       | \$1,765    | 0.8       | (\$4,320) |
| CZ05         | PGE/SCG               | 16.9              | 1.1                    | 3,309                     | 2                           | \$1,031              | \$23,520           | \$12,222         | \$21,774           | 1.1       | \$1,746    | 0.8       | (\$4,320) |
| CZ06         | SCE/SCG               | 19.8              | 1.2                    | 3,285                     | 1                           | \$953                | \$21,468           | \$12,050         | \$21,543           | 1.0       | (\$75)     | 0.8       | (\$3,431) |
| CZ07         | SDGE                  | 20.3              | 1.2                    | 3,278                     | 0                           | \$1,296              | \$31,370           | \$12,424         | \$22,045           | 1.4       | \$9,325    | 0.8       | (\$4,187) |
| CZ08         | SCE/SCG               | 20.4              | 0.5                    | 3,505                     | 0                           | \$1,040              | \$23,434           | \$12,609         | \$22,292           | 1.1       | \$1,141    | 0.8       | (\$3,179) |
| CZ09         | SCE                   | 19.6              | 0.5                    | 3,497                     | 0                           | \$1,030              | \$23,213           | \$12,347         | \$21,941           | 1.1       | \$1,272    | 0.8       | (\$2,974) |
| CZ10         | SCE/SCG               | 19.0              | 0.6                    | 729                       | 0                           | \$537                | \$12,107           | \$8,092          | \$16,220           | 0.7       | (\$4,113)  | 0.5       | (\$7,000) |
| CZ10         | SDGE                  | 19.0              | 0.6                    | 729                       | 0                           | \$813                | \$19,671           | \$8,092          | \$16,220           | 1.2       | \$3,451    | 0.5       | (\$7,000) |
| CZ11         | PGE                   | 17.6              | 3.0                    | 871                       | 10                          | \$663                | \$15,273           | \$8,874          | \$17,182           | 0.9       | (\$1,909)  | 0.7       | (\$5,184) |
| CZ12         | PGE                   | 16.7              | 2.7                    | 3,594                     | 9                           | \$1,112              | \$25,496           | \$13,450         | \$23,324           | 1.1       | \$2,172    | 0.9       | (\$2,978) |
| CZ12         | SMUD/PGE              | 16.7              | 2.7                    | 3,594                     | 9                           | \$537                | \$12,380           | \$14,500         | \$24,558           | 0.5       | (\$12,178) | 0.8       | (\$4,028) |
| CZ13         | PGE                   | 14.5              | 2.2                    | 273                       | 0                           | \$551                | \$12,569           | \$7,635          | \$15,518           | 0.8       | (\$2,949)  | 0.5       | (\$6,560) |
| CZ14         | SCE/SCG               | 14.5              | 3.2                    | 3,499                     | 0                           | \$1,006              | \$22,671           | \$12,471         | \$21,939           | 1.0       | \$732      | 0.8       | (\$3,079) |
| CZ14         | SDGE                  | 14.5              | 3.2                    | 3,499                     | 0                           | \$1,351              | \$32,711           | \$12,471         | \$21,939           | 1.5       | \$10,772   | 0.8       | (\$3,079) |
| CZ15         | SCE/SCG               | 19.2              | 1.8                    | 551                       | 0                           | \$683                | \$15,387           | \$8,134          | \$16,188           | 1.0       | (\$801)    | 0.5       | (\$6,677) |
| CZ16         | PG&E                  | 18.3              | 6.3                    | 3,680                     | 24                          | \$1,117              | \$25,838           | \$13,274         | \$23,130           | 1.1       | \$2,708    | 0.8       | (\$3,161) |

## 4.5 Greenhouse Gas Reductions

Table 20 and Table 21 present greenhouse gas reductions for the single family and ADU prototypes, respectively. Savings represent average annual savings over the 30-year lifetime of the analysis. Greenhouse gas reductions are greatest for the all-electric Efficiency + PV + Battery package in all cases. For the single family homes, the all-electric Code Minimum case reduces greenhouse gas emissions as much or greater than the mixed fuel Efficiency + PV + Battery package in Climate Zones 1 through 4, 11 through 13, and 16—showcasing the benefit of all-electric construction over even the most ambitious of mixed fuel construction packages evaluated in this study. The trend differs for the ADU where the mixed fuel Efficiency + PV + Battery package results in more greenhouse gas savings than the all-electric Code Minimum in all climate zones except Climate Zones 3, 4, and 13. In most of the climate zones (1, 2, 5 through 12, 15, and 16) the all-electric ADU involves electrification of space heating, cooking, and clothes drying. The space heating loads for the ADU are very low, even in the colder climates, and as a result the greenhouse gas savings from efficiency measures, PV and battery are greater than just code minimum electrification. This is also the case for single family homes in Climate Zones 5 through 10, and 15 where space heating loads are low.

**Table 20: Single Family Greenhouse Gas Reductions (metric tons)**

| Climate Zone | Single Family All-Electric |                 |  |                 |                           | Single Family Mixed Fuel               |                           |
|--------------|----------------------------|-----------------|--|-----------------|---------------------------|--|---------------------------|
|              | Code Minimum               | Efficiency Only | Efficiency + High Efficiency Equipment | Efficiency + PV | Efficiency + PV + Battery | Efficiency + High Efficiency Equipment | Efficiency + PV + Battery |
| CZ01         | 1.5                        | 1.7             | 1.8                                    | 1.8             | 2.3                       | 0.8                                    | 1.1                       |
| CZ02         | 0.9                        | 1.0             | 1.1                                    | 1.1             | 1.6                       | 0.5                                    | 0.7                       |
| CZ03         | 0.7                        | 0.7             | 0.8                                    | 0.8             | 1.3                       | 0.2                                    | 0.5                       |
| CZ04         | 0.7                        | 0.7             | 0.8                                    | 0.8             | 1.3                       | 0.2                                    | 0.5                       |
| CZ05         | 0.4                        | 0.5             | 0.6                                    | 0.6             | 1.1                       | 0.2                                    | 0.6                       |
| CZ06         | 0.3                        | 0.3             | 0.3                                    | 0.4             | 0.9                       | 0.1                                    | 0.5                       |
| CZ07         | 0.2                        | 0.2             | 0.3                                    | 0.3             | 0.8                       | 0.1                                    | 0.5                       |
| CZ08         | 0.2                        | 0.2             | 0.3                                    | 0.3             | 0.8                       | 0.1                                    | 0.5                       |
| CZ09         | 0.3                        | 0.3             | 0.3                                    | 0.4             | 0.9                       | 0.1                                    | 0.5                       |
| CZ10         | 0.3                        | 0.4             | 0.4                                    | 0.5             | 1.0                       | 0.1                                    | 0.5                       |
| CZ11         | 0.8                        | 0.9             | 1.0                                    | 1.0             | 1.5                       | 0.4                                    | 0.7                       |
| CZ12         | 0.7                        | 0.8             | 0.9                                    | 0.9             | 1.4                       | 0.4                                    | 0.6                       |
| CZ13         | 0.6                        | 0.7             | 0.8                                    | 0.8             | 1.3                       | 0.2                                    | 0.6                       |
| CZ14         | 0.6                        | 0.7             | 0.8                                    | 0.9             | 1.4                       | 0.2                                    | 0.6                       |
| CZ15         | 0.2                        | 0.2             | 0.3                                    | 0.3             | 0.7                       | 0.1                                    | 0.5                       |
| CZ16         | 1.4                        | 1.7             | 1.7                                    | 1.9             | 2.3                       | 1.0                                    | 1.1                       |

Table 21: ADU Greenhouse Gas Reductions (metric tons)

| Climate Zone | ADU All-Electric |                 |  |                 |                           | ADU Mixed Fuel                         |                           |
|--------------|------------------|-----------------|--|-----------------|---------------------------|--|---------------------------|
|              | Code Minimum     | Efficiency Only | Efficiency + High Efficiency Equipment | Efficiency + PV | Efficiency + PV + Battery | Efficiency + High Efficiency Equipment | Efficiency + PV + Battery |
| CZ01         | 0.4              | 0.5             | 0.5                                    | 0.6             | 1.0                       | 0.2                                    | 0.5                       |
| CZ02         | 0.2              | 0.3             | 0.3                                    | 0.4             | 0.8                       | 0.1                                    | 0.5                       |
| CZ03         | 0.5              | 0.5             | 0.6                                    | 0.7             | 1.0                       | 0.1                                    | 0.3                       |
| CZ04         | 0.5              | 0.5             | 0.5                                    | 0.7             | 1.0                       | 0.1                                    | 0.4                       |
| CZ05         | 0.1              | 0.2             | 0.2                                    | 0.3             | 0.7                       | 0.0                                    | 0.4                       |
| CZ06         | 0.1              | 0.1             | 0.1                                    | 0.3             | 0.6                       | 0.0                                    | 0.4                       |
| CZ07         | 0.1              | 0.1             | 0.1                                    | 0.3             | 0.6                       | 0.0                                    | 0.4                       |
| CZ08         | 0.1              | 0.1             | 0.1                                    | 0.3             | 0.6                       | 0.0                                    | 0.5                       |
| CZ09         | 0.1              | 0.1             | 0.1                                    | 0.3             | 0.7                       | 0.0                                    | 0.5                       |
| CZ10         | 0.1              | 0.1             | 0.2                                    | 0.2             | 0.6                       | 0.0                                    | 0.4                       |
| CZ11         | 0.2              | 0.3             | 0.3                                    | 0.3             | 0.7                       | 0.1                                    | 0.4                       |
| CZ12         | 0.2              | 0.3             | 0.3                                    | 0.4             | 0.7                       | 0.1                                    | 0.5                       |
| CZ13         | 0.4              | 0.5             | 0.5                                    | 0.5             | 0.9                       | 0.1                                    | 0.3                       |
| CZ14         | 0.4              | 0.5             | 0.5                                    | 0.7             | 1.1                       | 0.1                                    | 0.5                       |
| CZ15         | 0.1              | 0.1             | 0.1                                    | 0.2             | 0.6                       | 0.0                                    | 0.4                       |
| CZ16         | 0.4              | 0.5             | 0.5                                    | 0.7             | 1.0                       | 0.2                                    | 0.6                       |

## 4.6 Sensitivity Analysis

In response to jurisdictional interest, several cases were evaluated under circumstances different than those presented above in order to assess their impact on cost-effectiveness. Altered circumstances include:

1. CARE versus standard tariffs. This comparison is presented for the all-electric Code Minimum and the mixed fuel Efficiency + PV+ Battery packages and shows the impact on On-Bill cost-effectiveness for income qualified utility customers.
2. Infill versus new subdivision single family developments. This comparison applied to the all-electric Code Minimum package demonstrates how cost-effectiveness is impacted due to the magnitude of cost savings for all-electric construction from elimination of the natural gas infrastructure.
3. Utility rate escalation factors. The impact on On-Bill cost-effectiveness is presented for the all-electric Code Minimum package from varying the assumptions for escalation of electricity and natural gas utility rates over the 30-year analysis period.

#### 4.6.1 CARE Rate Comparison

Table 22 and Table 23 present a comparison of On-Bill cost-effectiveness results for CARE tariffs relative to standard IOU tariffs for the all-electric Code Minimum package for the single family and ADU prototypes, respectively. Applying the CARE rates lowers both electric and gas utility bills for the consumer. In the case of the all-electric home, the net impact of CARE rates is improved cost-effectiveness relative to the standard tariffs. This is because the discount on electricity is greater than that for natural gas. The opposite trend occurs for the mixed fuel packages, where the lower CARE rates result in lower utility cost savings and subsequently lower benefit-to-cost ratios.

**Table 22: On-Bill Cost-Effectiveness with CARE Tariffs: All-Electric Code Minimum**

| Climate Zone | Electric /Gas Utility | Single Family |           |           |         | ADU       |            |           |           |
|--------------|-----------------------|---------------|-----------|-----------|---------|-----------|------------|-----------|-----------|
|              |                       | Standard      |           | CARE      |         | Standard  |            | CARE      |           |
|              |                       | B/C Ratio     | NPV       | B/C Ratio | NPV     | B/C Ratio | NPV        | B/C Ratio | NPV       |
| CZ01         | PGE                   | 0.9           | (\$268)   | >1        | \$3,886 | 0.7       | (\$2,077)  | 1.2       | \$696     |
| CZ02         | PGE                   | 1.6           | \$2,355   | 5.1       | \$5,107 | 0.7       | (\$1,742)  | 1.1       | \$580     |
| CZ03         | PGE                   | 1.0           | (\$90)    | 1.7       | \$1,968 | 0.0       | (\$7,581)  | 0.0       | (\$4,596) |
| CZ04         | PGE                   | 1.3           | \$979     | 2.3       | \$2,619 | 0.0       | (\$7,406)  | 0.0       | (\$4,526) |
| CZ05         | PGE                   | 1.3           | \$1,373   | 2.2       | \$3,467 | 0.7       | (\$1,912)  | 1.1       | \$237     |
| CZ05         | PGE/SCG               | 1.4           | \$1,823   | 2.5       | \$3,841 | 0.9       | (\$574)    | 1.4       | \$1,321   |
| CZ06         | SCE/SCG               | 1.6           | \$2,339   | 2.3       | \$3,535 | 0.9       | (\$318)    | 1.4       | \$1,225   |
| CZ07         | SDGE                  | 1.1           | \$624     | 2.1       | \$3,309 | 0.6       | (\$3,298)  | 0.9       | (\$627)   |
| CZ08         | SCE/SCG               | 1.7           | \$2,792   | 2.3       | \$3,945 | 0.9       | (\$289)    | 1.4       | \$1,231   |
| CZ09         | SCE                   | 1.7           | \$2,831   | 2.4       | \$4,074 | 0.9       | (\$310)    | 1.4       | \$1,230   |
| CZ10         | SCE/SCG               | 1.6           | \$2,642   | 2.4       | \$4,083 | 1.3       | \$976      | 1.7       | \$1,923   |
| CZ10         | SDGE                  | 1.4           | \$1,825   | 3.0       | \$4,642 | 0.8       | (\$1,084)  | 1.3       | \$1,114   |
| CZ11         | PGE                   | 1.7           | \$2,552   | 5.0       | \$5,077 | 1.0       | \$200      | 1.6       | \$1,634   |
| CZ12         | PGE                   | 1.9           | \$3,210   | 5.0       | \$5,587 | 0.7       | (\$1,710)  | 1.1       | \$545     |
| CZ13         | PGE                   | 1.5           | \$1,480   | 2.7       | \$2,924 | 0.0       | (\$4,131)  | 0.0       | (\$2,754) |
| CZ14         | SCE/SCG               | 0.9           | (\$522)   | 1.3       | \$1,191 | 0.0       | (\$7,375)  | 0.0       | (\$4,754) |
| CZ14         | SDGE                  | 0.7           | (\$1,717) | 2.0       | \$2,295 | 0.0       | (\$10,790) | 0.0       | (\$6,496) |
| CZ15         | SCE/SCG               | 1.4           | \$1,791   | 1.9       | \$2,831 | 1.4       | \$1,246    | 1.8       | \$2,031   |
| CZ16         | PG&E                  | 0.2           | (\$5,394) | 0.8       | (\$351) | 0.6       | (\$2,562)  | 1.1       | \$453     |

**Table 23: On-Bill Cost-Effectiveness with CARE Tariffs: Mixed Fuel Efficiency + PV+ Battery Package**

| Climate Zone | Electric /Gas Utility | Single Family |          |           |           | ADU       |           |           |           |
|--------------|-----------------------|---------------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
|              |                       | Standard      |          | CARE      |           | Standard  |           | CARE      |           |
|              |                       | B/C Ratio     | NPV      | B/C Ratio | NPV       | B/C Ratio | NPV       | B/C Ratio | NPV       |
| CZ01         | PGE                   | 1.3           | \$6,501  | 0.9       | (\$2,072) | 0.97      | (\$654)   | 0.7       | (\$8,623) |
| CZ02         | PGE                   | 1.1           | \$2,486  | 0.7       | (\$5,286) | 1.0       | \$524     | 0.7       | (\$7,297) |
| CZ03         | PGE                   | 1.1           | \$1,104  | 0.6       | (\$5,980) | 0.9       | (\$2,899) | 0.6       | (\$8,788) |
| CZ04         | PGE                   | 1.0           | \$456    | 0.6       | (\$6,790) | 0.9       | (\$1,625) | 0.6       | (\$8,200) |
| CZ05         | PGE                   | 1.1           | \$2,285  | 0.7       | (\$5,646) | 1.1       | \$1,765   | 0.7       | (\$6,142) |
| CZ05         | PGE/SCG               | 1.1           | \$2,154  | 0.7       | (\$5,751) | 1.1       | \$1,746   | 0.7       | (\$6,157) |
| CZ06         | SCE/SCG               | 1.1           | \$1,951  | 0.7       | (\$5,232) | 0.997     | (\$75)    | 0.7       | (\$5,476) |
| CZ07         | SDGE                  | 1.6           | \$9,869  | 1.1       | \$1,502   | 1.4       | \$9,325   | 0.9       | (\$1,935) |
| CZ08         | SCE/SCG               | 1.2           | \$3,344  | 0.7       | (\$4,574) | 1.1       | \$1,141   | 0.8       | (\$4,945) |
| CZ09         | SCE                   | 1.2           | \$3,369  | 0.7       | (\$4,547) | 1.1       | \$1,272   | 0.8       | (\$4,812) |
| CZ10         | SCE/SCG               | 1.3           | \$4,546  | 0.8       | (\$3,683) | 0.7       | (\$4,113) | 0.5       | (\$7,624) |
| CZ10         | SDGE                  | 1.8           | \$14,148 | 1.3       | \$4,461   | 1.2       | \$3,451   | 0.8       | (\$2,615) |
| CZ11         | PGE                   | 1.4           | \$6,523  | 0.9       | (\$2,487) | 0.9       | (\$1,909) | 0.6       | (\$7,688) |
| CZ12         | PGE                   | 1.2           | \$3,451  | 0.7       | (\$4,560) | 1.1       | \$2,172   | 0.7       | (\$6,267) |
| CZ13         | PGE                   | 1.3           | \$5,665  | 0.8       | (\$3,372) | 0.8       | (\$2,949) | 0.5       | (\$8,111) |
| CZ14         | SCE/SCG               | 1.3           | \$5,945  | 0.8       | (\$3,074) | 1.0       | \$732     | 0.8       | (\$5,341) |
| CZ14         | SDGE                  | 1.8           | \$15,726 | 1.3       | \$4,718   | 1.5       | \$10,772  | 1.0       | (\$1,007) |
| CZ15         | SCE/SCG               | 1.5           | \$9,078  | 0.9       | (\$877)   | 0.95      | (\$801)   | 0.6       | (\$6,322) |
| CZ16         | PG&E                  | 1.3           | \$5,254  | 0.8       | (\$3,523) | 1.1       | \$2,708   | 0.8       | (\$5,611) |

## 4.6.2 Utility Infrastructure Cost Sensitivity

Table 24 compares cost-effectiveness results for the natural gas service line extension cost scenarios that inform the average values presented in Table 8. The average cost scenario reflects the cost-effectiveness results for the single family all-electric Code Minimum package presented in Table 16. Relative to a new subdivision, gas infrastructure cost savings are higher for the infill development case, which translates to higher cost-effectiveness. This is shown by positive cost-effectiveness in all metrics except one – On-Bill for Climate Zone 16 – for infill development. Compared to the average cost scenario, there are two cases – On-Bill for Climate Zone 4 in PG&E territory and Climate Zone 7 – where the all-electric Code Minimum package is no longer cost-effective based on the new subdivision costs.

**Table 24: Single Family Cost-Effectiveness Comparison with Range of Natural Gas Utility Infrastructure Costs: All-Electric Code Minimum**

| Climate Zone | Electric /Gas Utility | Average   |           |           |           | New Subdivision |           |           |           | Infill Development |          |           |          |
|--------------|-----------------------|-----------|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|--------------------|----------|-----------|----------|
|              |                       | On-Bill   |           | TDV       |           | On-Bill         |           | TDV       |           | On-Bill            |          | TDV       |          |
|              |                       | B/C Ratio | NPV       | B/C Ratio | NPV       | B/C Ratio       | NPV       | B/C Ratio | NPV       | B/C Ratio          | NPV      | B/C Ratio | NPV      |
| CZ01         | PGE                   | 0.9       | (\$268)   | >1        | \$5,702   | 0.6             | (\$1,492) | >1        | \$4,612   | 2.2                | \$4,628  | >1        | \$10,062 |
| CZ02         | PGE                   | 1.6       | \$2,355   | >1        | \$7,711   | 1.3             | \$1,131   | >1        | \$6,621   | 2.8                | \$7,250  | >1        | \$12,071 |
| CZ03         | PGE                   | 0.98      | (\$90)    | 25.3      | \$3,887   | 0.7             | (\$1,314) | 18.5      | \$2,797   | 2.0                | \$4,806  | 52.6      | \$8,247  |
| CZ04         | PGE                   | 1.3       | \$979     | >1        | \$4,494   | 0.9             | (\$245)   | >1        | \$3,404   | 2.6                | \$5,875  | >1        | \$8,854  |
| CZ04         | CPAU                  | >1        | \$10,437  | >1        | \$7,762   | >1              | \$10,437  | >1        | \$7,762   | >1                 | \$10,437 | >1        | \$7,762  |
| CZ05         | PGE                   | 1.3       | \$1,373   | 6.1       | \$4,633   | 1.0             | \$149     | 4.9       | \$3,543   | 2.3                | \$6,269  | 11.0      | \$8,993  |
| CZ05         | PGE/SCG               | 1.4       | \$1,823   | 6.1       | \$4,633   | 1.1             | \$599     | 4.9       | \$3,543   | 2.5                | \$6,719  | 11.0      | \$8,993  |
| CZ06         | SCE/SCG               | 1.6       | \$2,339   | 4.7       | \$4,353   | 1.3             | \$1,115   | 3.8       | \$3,263   | 2.8                | \$7,235  | 8.4       | \$8,713  |
| CZ07         | SDGE                  | 1.1       | \$624     | 4.2       | \$4,211   | 0.9             | (\$600)   | 3.4       | \$3,121   | 2.0                | \$5,519  | 7.5       | \$8,571  |
| CZ08         | SCE/SCG               | 1.7       | \$2,792   | 4.2       | \$4,674   | 1.4             | \$1,568   | 3.5       | \$3,584   | 2.8                | \$7,687  | 7.3       | \$9,034  |
| CZ09         | SCE                   | 1.7       | \$2,831   | 5.5       | \$5,013   | 1.4             | \$1,607   | 4.6       | \$3,923   | 2.9                | \$7,726  | 9.5       | \$9,373  |
| CZ10         | SCE/SCG               | 1.6       | \$2,642   | 7.4       | \$5,287   | 1.3             | \$1,418   | 6.1       | \$4,197   | 2.7                | \$7,537  | 12.6      | \$9,647  |
| CZ10         | SDGE                  | 1.4       | \$1,825   | 7.4       | \$5,287   | 1.1             | \$601     | 6.1       | \$4,197   | 2.3                | \$6,721  | 12.6      | \$9,647  |
| CZ11         | PGE                   | 1.7       | \$2,552   | >1        | \$7,153   | 1.3             | \$1,328   | >1        | \$6,063   | 3.0                | \$7,448  | >1        | \$11,513 |
| CZ12         | PGE                   | 1.9       | \$3,210   | >1        | \$7,504   | 1.5             | \$1,986   | >1        | \$6,414   | 3.1                | \$8,106  | >1        | \$11,864 |
| CZ12         | SMUD/PGE              | >1        | \$11,714  | >1        | \$7,504   | >1              | \$10,490  | >1        | \$6,414   | >1                 | \$16,610 | >1        | \$11,864 |
| CZ13         | PGE                   | 1.5       | \$1,480   | >1        | \$4,490   | 1.1             | \$256     | >1        | \$3,400   | 3.0                | \$6,376  | >1        | \$8,850  |
| CZ14         | SCE/SCG               | 0.9       | (\$522)   | >1        | \$4,105   | 0.7             | (\$1,746) | >1        | \$3,015   | 1.8                | \$4,374  | >1        | \$8,465  |
| CZ14         | SDGE                  | 0.7       | (\$1,717) | >1        | \$4,105   | 0.5             | (\$2,941) | >1        | \$3,015   | 1.5                | \$3,179  | >1        | \$8,465  |
| CZ15         | SCE/SCG               | 1.4       | \$1,791   | 3.0       | \$3,439   | 1.1             | \$567     | 2.4       | \$2,349   | 2.6                | \$6,687  | 5.6       | \$7,799  |
| CZ16         | PG&E                  | 0.2       | (\$5,394) | 0.4       | (\$1,339) | 0.0             | (\$6,618) | 0.0       | (\$2,429) | 0.9                | (\$498)  | 2.4       | \$3,021  |

### 4.6.3 Utility Rate Escalation

In this sensitivity analysis, an alternative set of annual utility escalation rates was applied to the gas and electricity savings in select measure packages to show the impact that utility cost changes over time have on cost-effectiveness. This set of rates, detailed in Section 7.2.7, reflects those used by the Energy Commission in their development of the LSC factors for the 2025 code cycle (LSC replaces TDV in the 2025 code cycle). The rates assume steep increases in gas rates starting in 2030. Increased gas rates range from 2% to 6.7% higher than annual rates used in the 2022 code cycle; electricity rates are only marginally (about 0.5%) higher each year.

On-Bill cost-effectiveness results are shown for in Table 25 for the all-electric Code Minimum scenario and Table 26 for the mixed fuel Efficiency + PV + Battery measure package. The alternative rates described above ("2025 LSC") are shown alongside those reported elsewhere in this report ("CPUC / 2022 TDV", described in Section 2.1.3) for comparison. In all cases, the 2025 LSC escalation rates improve cost-effectiveness. In some cases, this improvement is enough to change the result from not cost-effective to cost-effective, these cases are summarized below:

- All-Electric Code Minimum package
  - Climate Zones 1, 3, 14, and 16 for the single family home
  - Climate Zones 1, 5 in PG&E/SCG territory, 6, 8, 9, 10 in SDG&E territory, and 16 for the ADU home
- Mixed fuel Efficiency + PV + Battery package
  - Climate Zones 1, 6, and 15 for the ADU home

**Table 25: Cost-Effectiveness, 2025 LSC Basis: All-Electric Code Minimum**

| Climate Zone | Electric /Gas Utility | Single Family   |           |           |          | ADU             |            |           |           |
|--------------|-----------------------|-----------------|-----------|-----------|----------|-----------------|------------|-----------|-----------|
|              |                       | CPUC / 2022 TDV |           | 2025 LSC  |          | CPUC / 2022 TDV |            | 2025 LSC  |           |
|              |                       | B/C Ratio       | NPV       | B/C Ratio | NPV      | B/C Ratio       | NPV        | B/C Ratio | NPV       |
| CZ01         | PGE                   | 0.9             | (\$268)   | >1        | \$13,867 | 0.7             | (\$2,077)  | 1.2       | \$833     |
| CZ02         | PGE                   | 1.6             | \$2,355   | >1        | \$10,458 | 0.7             | (\$1,742)  | 0.95      | (\$228)   |
| CZ03         | PGE                   | 0.98            | (\$90)    | >1        | \$4,883  | 0.0             | (\$7,581)  | 0.0       | (\$4,465) |
| CZ04         | PGE                   | 1.3             | \$979     | >1        | \$5,728  | 0.0             | (\$7,406)  | 0.0       | (\$4,466) |
| CZ04         | CPAU                  | >1              | \$10,437  | >1        | \$17,647 | 6.9             | \$2,592    | 20.7      | \$8,704   |
| CZ05         | PGE                   | 1.3             | \$1,373   | 5.3       | \$5,148  | 0.7             | (\$1,912)  | 0.8       | (\$1,386) |
| CZ05         | PGE/SCG               | 1.4             | \$1,823   | 13.5      | \$5,884  | 0.9             | (\$574)    | 1.2       | \$807     |
| CZ06         | SCE/SCG               | 1.6             | \$2,339   | 4.0       | \$4,751  | 0.9             | (\$318)    | 1.2       | \$630     |
| CZ07         | SDGE                  | 1.1             | \$624     | 1.9       | \$3,008  | 0.6             | (\$3,298)  | 0.7       | (\$2,394) |
| CZ08         | SCE/SCG               | 1.7             | \$2,792   | 3.0       | \$4,650  | 0.9             | (\$289)    | 1.1       | \$591     |
| CZ09         | SCE                   | 1.7             | \$2,831   | 4.0       | \$5,233  | 0.9             | (\$310)    | 1.2       | \$634     |
| CZ10         | SCE/SCG               | 1.6             | \$2,642   | 5.4       | \$5,700  | 1.3             | \$976      | 1.9       | \$2,147   |
| CZ10         | SDGE                  | 1.4             | \$1,825   | 7.4       | \$6,038  | 0.8             | (\$1,084)  | 1.0       | \$102     |
| CZ11         | PGE                   | 1.7             | \$2,552   | >1        | \$9,997  | 1.0             | \$200      | 1.6       | \$1,669   |
| CZ12         | PGE                   | 1.9             | \$3,210   | >1        | \$10,077 | 0.7             | (\$1,710)  | 0.9       | (\$430)   |
| CZ12         | SMUD/PGE              | >1              | \$11,714  | >1        | \$19,028 | 5.7             | \$3,797    | >1        | \$5,367   |
| CZ13         | PGE                   | 1.5             | \$1,480   | >1        | \$5,987  | 0.0             | (\$4,131)  | 0.0       | (\$1,228) |
| CZ14         | SCE/SCG               | 0.9             | (\$522)   | 6.0       | \$3,876  | 0.0             | (\$7,375)  | 0.0       | (\$4,363) |
| CZ14         | SDGE                  | 0.7             | (\$1,717) | >1        | \$4,799  | 0.0             | (\$10,790) | 0.0       | (\$6,285) |
| CZ15         | SCE/SCG               | 1.4             | \$1,791   | 2.2       | \$3,214  | 1.4             | \$1,246    | 1.9       | \$2,210   |
| CZ16         | PG&E                  | 0.2             | (\$5,394) | >1        | \$8,516  | 0.6             | (\$2,562)  | 1.2       | \$629     |

**Table 26: Cost-Effectiveness, 2025 LSC Basis: Mixed Fuel Efficiency + PV + Battery**

| Climate Zone | Electric /Gas Utility | Single Family   |            |           |            | ADU             |            |           |            |
|--------------|-----------------------|-----------------|------------|-----------|------------|-----------------|------------|-----------|------------|
|              |                       | CPUC / 2022 TDV |            | 2025 LSC  |            | CPUC / 2022 TDV |            | 2025 LSC  |            |
|              |                       | B/C Ratio       | NPV        | B/C Ratio | NPV        | B/C Ratio       | NPV        | B/C Ratio | NPV        |
| CZ01         | PGE                   | 1.3             | \$6,501    | 1.6       | \$12,598   | 1.0             | (\$654)    | 1.1       | \$1,379    |
| CZ02         | PGE                   | 1.1             | \$2,486    | 1.3       | \$4,914    | 1.0             | \$524      | 1.1       | \$2,202    |
| CZ03         | PGE                   | 1.1             | \$1,104    | 1.1       | \$2,287    | 0.9             | (\$2,899)  | 0.9       | (\$1,962)  |
| CZ04         | PGE                   | 1.0             | \$456      | 1.1       | \$1,645    | 0.9             | (\$1,625)  | 0.97      | (\$594)    |
| CZ04         | CPAU                  | 0.2             | (\$16,295) | 0.2       | (\$15,990) | 0.4             | (\$13,536) | 0.4       | (\$13,067) |
| CZ05         | PGE                   | 1.1             | \$2,285    | 1.2       | \$3,855    | 1.1             | \$1,765    | 1.1       | \$3,074    |
| CZ05         | PGE/SCG               | 1.1             | \$2,154    | 1.2       | \$3,639    | 1.1             | \$1,746    | 1.1       | \$3,043    |
| CZ06         | SCE/SCG               | 1.1             | \$1,951    | 1.2       | \$3,420    | 1.0             | (\$75)     | 1.1       | \$1,347    |
| CZ07         | SDGE                  | 1.6             | \$9,869    | 1.6       | \$9,831    | 1.4             | \$9,325    | 1.4       | \$9,070    |
| CZ08         | SCE/SCG               | 1.2             | \$3,344    | 1.3       | \$4,750    | 1.1             | \$1,141    | 1.1       | \$2,674    |
| CZ09         | SCE                   | 1.2             | \$3,369    | 1.3       | \$4,812    | 1.1             | \$1,272    | 1.1       | \$2,793    |
| CZ10         | SCE/SCG               | 1.3             | \$4,546    | 1.4       | \$6,006    | 0.7             | (\$4,113)  | 0.8       | (\$3,317)  |
| CZ10         | SDGE                  | 1.8             | \$14,148   | 1.8       | \$13,960   | 1.2             | \$3,451    | 1.2       | \$3,290    |
| CZ11         | PGE                   | 1.4             | \$6,523    | 1.5       | \$8,837    | 0.9             | (\$1,909)  | 0.96      | (\$740)    |
| CZ12         | PGE                   | 1.2             | \$3,451    | 1.3       | \$5,457    | 1.1             | \$2,172    | 1.2       | \$3,844    |
| CZ12         | SMUD/PGE              | 0.3             | (\$13,066) | 0.4       | (\$11,864) | 0.5             | (\$12,178) | 0.5       | (\$11,196) |
| CZ13         | PGE                   | 1.3             | \$5,665    | 1.4       | \$7,099    | 0.8             | (\$2,949)  | 0.9       | (\$2,288)  |
| CZ14         | SCE/SCG               | 1.3             | \$5,945    | 1.4       | \$7,729    | 1.0             | \$732      | 1.1       | \$2,213    |
| CZ14         | SDGE                  | 1.8             | \$15,726   | 1.8       | \$15,707   | 1.5             | \$10,772   | 1.5       | \$10,493   |
| CZ15         | SCE/SCG               | 1.5             | \$9,078    | 1.7       | \$10,819   | 1.0             | (\$801)    | 1.0       | \$204      |
| CZ16         | PG&E                  | 1.3             | \$5,254    | 1.5       | \$10,999   | 1.1             | \$2,708    | 1.2       | \$4,956    |

## 5 Summary

The purpose of this study was to examine and document the code compliance and cost-effectiveness impacts of improving performance among single family new construction – both standard sized homes and ADUs. To this end, the Reach Codes Team evaluated packages of energy efficiency measures as well as packages combining energy efficiency with solar PV generation and battery storage, simulated them in building modeling software, and gathered costs to determine the cost-effectiveness of multiple scenarios. The Reach Codes Team coordinated with multiple utilities, cities, and building community experts to develop a set of assumptions considered reasonable in the current market. Changing assumptions, such as the period of analysis, measure selection, cost assumptions, energy escalation rates, or utility tariffs are likely to change results.

Table 27 (single family) and Table 28 (ADU) summarize results for each prototype and depict the EDR1 compliance margins achieved for each climate zone and package. Because local reach codes must both exceed the energy code (i.e., have a positive compliance margin in the performance approach) and be cost-effective, the Reach Codes Team highlighted cells meeting these two requirements to help clarify the upper boundary for potential reach code policies. All results presented in this study have a positive compliance margin.

- Cells highlighted in **green** depict a positive compliance margin and cost-effective results using both On-Bill and TDV approaches.
- Cells highlighted in **yellow** depict a positive compliance and cost-effective results using either the On-Bill or TDV approach.
- Cells **not highlighted** depict a package that was not cost-effective using either the On-Bill or TDV approach.
- Cells highlighted in **grey** depict the high efficiency equipment packages where cost-effectiveness was not evaluated.

The following are key takeaways and recommendations from the analysis.

### Conclusions and Discussion:

- All-electric buildings have lower GHG emissions than mixed fuel buildings, due to the clean power sources currently available from California's power providers as well as accounting for increased penetration of renewables in the future. Almost all the all-electric packages evaluated resulted in greater GHG emission savings than the mixed fuel packages, with the exception of the mixed fuel package with battery storage in climate zones with low heating loads. The Reach Codes Team found code-compliant, all-electric new construction to be feasible and cost-effective based on TDV for single family homes in all cases except Climate Zone 16.
- All-electric single family new construction was On-Bill cost-effective in all cases except Climate Zones 1, 3, 14, and 16.
- The all-electric ADU home was cost-effective based on TDV in all cases except in Climate Zones 3, 4, 13, and 14 where the higher cost of installing a ducted HPWH instead of the prescriptively required gas tankless water heater outweigh the resulting energy cost savings. In the other climate zones there were first cost savings for installing a heat pump space heater instead of gas furnace, contributing to an overall TDV cost-effective result.
- Few cases were cost-effective On-Bill for the ADU.
- All-electric code minimum construction results in an increase in first year utility costs relative to a mixed fuel home, except for CPAU and SMUD where electricity rates are much lower than for the IOUs. The addition of efficiency measures, market dominant HPWHs that meet NEEA's Advanced Water Heating Specification, high efficiency heat pumps, increased PV, and batteries all reduce utility costs, and a combination of these options was found to reduce annual utility costs relative to a mixed fuel home in all cases.
- Under NBT, utility cost savings for increasing PV system size beyond code minimum are substantially less than under prior net energy metering rules (NEM 2.0); however, savings are sufficient to be On-Bill cost-effective in all climate zones for the all-electric single family home. Coupling PV with battery systems increases utility cost savings as a result of improved on-site utilization of PV generation and fewer exports to the grid.

- Applying CARE rates in the IOU territories increases improves On-Bill cost-effectiveness for all-electric buildings, as compared to the same case under standard rates, due to higher utility cost savings compared to a code compliant mixed fuel building also on a CARE rate, improving On-Bill cost-effectiveness. This is due to the CARE discount on electricity being higher than that on gas.
- If gas tariffs are assumed to increase substantially over time, in-line with the escalation assumption from the 2025 LSC development, all-electric new construction was found to be On-Bill cost-effective in almost all scenarios over the 30-year analysis period. 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. 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.<sup>21</sup> 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 including incentivizing electrification, it also will make building efficiency measures harder to justify as cost-effective due to lower utility bill cost savings.

### Recommendations:

- A reach code with a single performance target based on source energy (EDR1) can be structured to strongly encourage electrification. This approach requires equivalent performance for all buildings and allows mixed fuel buildings which minimizes the risk of violating federal preemption. Below are examples of how a reach code for single family homes could be setup based on the results summarized in Table 27.
  - A jurisdiction in Climate Zone 12 could set a performance target at an EDR1 margin of 11.5 (the EDR1 margin for the all-electric Code Minimum package). Any all-electric home meeting or exceeding the prescriptive requirements would comply, and a mixed fuel home would likely need to incorporate a combination of efficiency measures and a battery system to comply.
  - Similarly, a jurisdiction in Climate Zone 7 may consider setting a performance target of 2.8 EDR1 margin (also the EDR1 margin for the all-electric Code Minimum package). Any all-electric home meeting or exceeding the prescriptive requirements would comply, but a mixed fuel home would likely be able to comply with only a suite of above-code efficiency measures (no battery). Alternatively, a higher EDR1 margin target of 5 would incentivize more energy efficiency or additional PV for all-electric construction, and mixed fuel construction would likely need to incorporate a battery system to comply.
  - A jurisdiction in Climate Zone 16 may want to set a performance target at an EDR1 margin of 20.5 (the EDR1 margin for the mixed fuel efficiency + PV + battery package). This would establish a target that a mixed fuel home could cost-effectively meet, likely only after incorporating a combination of efficiency measures and a battery system, and that an all-electric home could easily meet.
- The 2022 Title 24 code's new source energy metric combined with the heat pump baseline encourage all-electric construction, providing an incentive that allows for some amount of prescriptively required building efficiency to be traded off, still meeting minimum code compliance. This compliance benefit for all-electric homes highlights a unique opportunity for jurisdictions to incorporate efficiency into all-electric reach codes. 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. The Reach Codes Team recommends that jurisdictions adopting a reach code for single family buildings also include an efficiency requirement with EDR1 margins at minimum consistent with the all-electric code minimum package results in Table 27.

<sup>21</sup> <https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking>

- The code compliance margins for the ADU all-electric code minimum package are lower than for the single family prototype; code compliance and cost-effectiveness can be more challenging for smaller dwelling units. As a result, the Reach Codes Team does not recommend EDR1 targets above those reported for the all-electric Code Minimum package in Table 28.

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, jurisdictions may amend Part 11 instead of Part 6 of the CA Building Code requiring review and approval by the BSC but not the Energy Commission. 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.

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/>.

**Table 27: Summary of Single Family EDR1 Margins and Cost-Effectiveness**

| Climate Zone | Electric /Gas Utility | All-Electric |            |  |                 |                           | Mixed Fuel                             |                           |
|--------------|-----------------------|--------------|------------|--|-----------------|---------------------------|--|---------------------------|
|              |                       | Code Minimum | Efficiency | Efficiency + High Efficiency Equipment | Efficiency + PV | Efficiency + PV + Battery | Efficiency + High Efficiency Equipment | Efficiency + PV + Battery |
| CZ01         | PGE                   | 25.8         | 29.1       | 31.4                                   | 32.6            | 41.4                      | 14.8                                   | 22.6                      |
| CZ02         | PGE                   | 14.0         | 16.3       | 18.0                                   | 18.9            | 28.3                      | 9.1                                    | 14.1                      |
| CZ03         | PGE                   | 9.1          | 10.6       | 12.2                                   | 13.1            | 24.2                      | 3.6                                    | 12.8                      |
| CZ04         | PGE                   | 8.8          | 10.4       | 11.9                                   | 12.8            | 24.6                      | 3.8                                    | 13.2                      |
| CZ04         | CPAU                  | 8.8          | 10.4       | 11.9                                   | 12.8            | 24.6                      | 3.8                                    | 13.2                      |
| CZ05         | PGE                   | 6.5          | 7.9        | 10.2                                   | 10.8            | 23.3                      | 5.2                                    | 14.8                      |
| CZ05         | PGE/SCG               | 6.5          | 7.9        | 10.2                                   | 10.8            | 23.3                      | 5.2                                    | 14.8                      |
| CZ06         | SCE/SCG               | 4.2          | 5.3        | 6.6                                    | 8.4             | 24.6                      | 4.0                                    | 18.3                      |
| CZ07         | SDGE                  | 2.8          | 3.6        | 4.8                                    | 6.9             | 23.6                      | 3.2                                    | 18.7                      |
| CZ08         | SCE/SCG               | 2.1          | 2.9        | 4.2                                    | 5.6             | 21.3                      | 2.7                                    | 17.1                      |
| CZ09         | SCE/SCG               | 3.6          | 4.4        | 5.7                                    | 7.1             | 21.8                      | 3.2                                    | 16.2                      |
| CZ10         | SCE/SCG               | 4.8          | 5.8        | 7.2                                    | 8.5             | 21.9                      | 3.9                                    | 14.4                      |
| CZ10         | SDGE                  | 4.8          | 5.8        | 7.2                                    | 8.5             | 21.9                      | 3.9                                    | 14.4                      |
| CZ11         | PGE                   | 11.4         | 13.4       | 15.0                                   | 15.6            | 24.5                      | 7.7                                    | 12.9                      |
| CZ12         | PGE                   | 11.5         | 13.3       | 14.8                                   | 15.5            | 25.2                      | 7.2                                    | 13.2                      |
| CZ12         | SMUD/PGE              | 11.5         | 13.3       | 14.8                                   | 15.5            | 25.2                      | 7.2                                    | 13.2                      |
| CZ13         | PGE                   | 8.3          | 10.3       | 11.9                                   | 12.3            | 22.3                      | 4.1                                    | 12.3                      |
| CZ14         | SCE/SCG               | 8.8          | 11.5       | 13.2                                   | 14.3            | 24.7                      | 4.6                                    | 13.4                      |
| CZ14         | SDGE                  | 8.8          | 11.5       | 13.2                                   | 14.3            | 24.7                      | 4.6                                    | 13.4                      |
| CZ15         | SCE/SCG               | 0.9          | 2.4        | 3.7                                    | 3.8             | 15.7                      | 3.5                                    | 13.5                      |
| CZ16         | PG&E                  | 21.3         | 25.6       | 27.0                                   | 29.1            | 37.5                      | 16.3                                   | 20.4                      |

Table 28: Summary of ADU EDR1 Margins and Cost-Effectiveness

| Climate Zone | Electric /Gas Utility | All-Electric |            |  |                 |                           | Mixed Fuel                             |                           |
|--------------|-----------------------|--------------|------------|--|-----------------|---------------------------|--|---------------------------|
|              |                       | Code Minimum | Efficiency | Efficiency + High Efficiency Equipment | Efficiency + PV | Efficiency + PV + Battery | Efficiency + High Efficiency Equipment | Efficiency + PV + Battery |
| CZ01         | PGE                   | 11.9         | 15.7       | 18.5                                   | 19.3            | 33.7                      | 2.9                                    | 18.5                      |
| CZ02         | PGE                   | 5.7          | 7.9        | 9.7                                    | 10.8            | 25.6                      | -4.7                                   | 16.6                      |
| CZ03         | PGE                   | 2.9          | 4.0        | 5.9                                    | 7.1             | 23.2                      | 4.0                                    | 11.8                      |
| CZ04         | PGE                   | 2.4          | 3.9        | 5.5                                    | 6.8             | 23.6                      | 4.2                                    | 13.3                      |
| CZ04         | CPAU                  | 2.4          | 3.9        | 5.5                                    | 6.8             | 23.6                      | 4.2                                    | 13.3                      |
| CZ05         | PGE                   | 1.8          | 2.9        | 4.8                                    | 6.4             | 24.0                      | -12.1                                  | 16.9                      |
| CZ05         | PGE/SCG               | 1.8          | 2.9        | 4.8                                    | 6.4             | 24.0                      | -12.1                                  | 16.9                      |
| CZ06         | SCE/SCG               | 0.5          | 1.3        | 2.6                                    | 5.0             | 25.7                      | -15.6                                  | 19.8                      |
| CZ07         | SDGE                  | 0.1          | 0.9        | 2.1                                    | 5.0             | 26.4                      | -16.5                                  | 20.3                      |
| CZ08         | SCE/SCG               | 0.1          | 0.7        | 1.8                                    | 4.2             | 25.1                      | -15.3                                  | 20.4                      |
| CZ09         | SCE                   | 0.4          | 1.1        | 2.3                                    | 4.5             | 25.0                      | -14.4                                  | 19.6                      |
| CZ10         | SCE/SCG               | 1.0          | 2.0        | 3.5                                    | 5.4             | 25.3                      | -11.9                                  | 19.0                      |
| CZ10         | SDGE                  | 1.0          | 2.0        | 3.5                                    | 5.4             | 25.3                      | -11.9                                  | 19.0                      |
| CZ11         | PGE                   | 4.6          | 7.0        | 8.6                                    | 9.6             | 25.1                      | -3.5                                   | 17.6                      |
| CZ12         | PGE                   | 4.6          | 6.6        | 8.3                                    | 9.3             | 24.5                      | -5.6                                   | 16.7                      |
| CZ12         | SMUD/PGE              | 4.6          | 6.6        | 8.3                                    | 9.3             | 24.5                      | -5.6                                   | 16.7                      |
| CZ13         | PGE                   | 3.1          | 5.5        | 6.9                                    | 7.8             | 25.2                      | 4.4                                    | 14.5                      |
| CZ14         | SCE/SCG               | 3.5          | 6.3        | 8.0                                    | 9.6             | 26.9                      | 5.1                                    | 14.5                      |
| CZ14         | SDGE                  | 3.5          | 6.3        | 8.0                                    | 9.6             | 26.9                      | 5.1                                    | 14.5                      |
| CZ15         | SCE/SCG               | 0.0          | 2.2        | 2.6                                    | 4.4             | 25.3                      | -9.3                                   | 19.2                      |
| CZ16         | PG&E                  | 11.2         | 14.7       | 15.7                                   | 18.3            | 33.7                      | 2.9                                    | 18.3                      |

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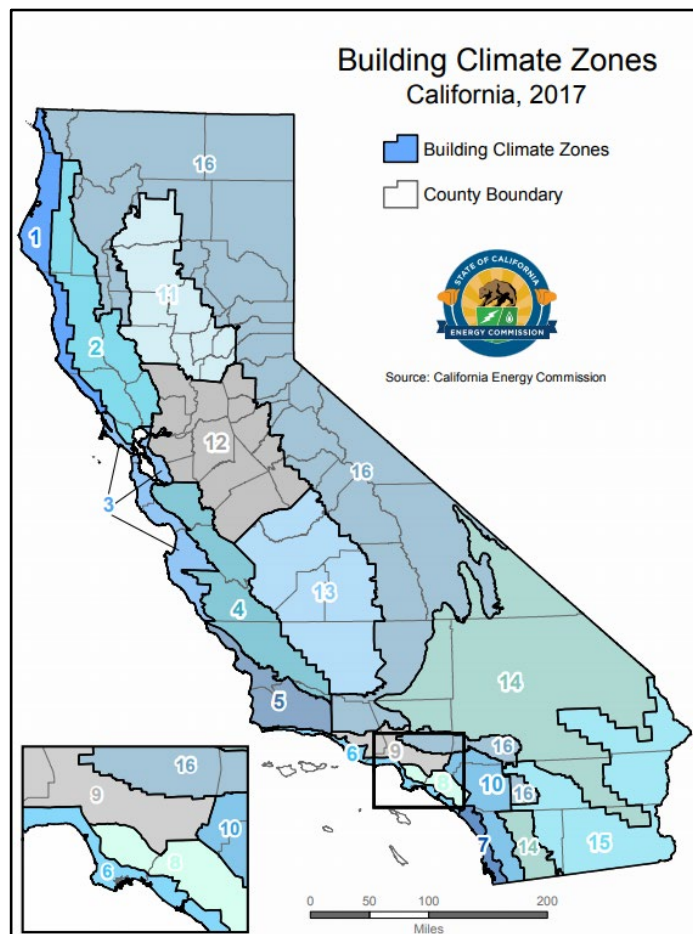
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## 7 Appendices

### 7.1 Map of California Climate Zones

Climate zone geographical boundaries are depicted in Figure 4. The map in Figure 4 along with a zip-code search directory is available at: [https://ww2.energy.ca.gov/maps/renewable/building\\_climate\\_zones.html](https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html)

**Figure 4: Map of California climate zones.**



## 7.2 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.<sup>22</sup> 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     |
|------------------|-------------------|-------|-----|------|------|-----|------|---------|
| <b>PG&amp;E</b>  | \$38.39           |       |     |      |      |     |      | \$38.39 |
| <b>SCE</b>       | \$71.00           |       |     |      |      |     |      | \$71.00 |
| <b>SDG&amp;E</b> | \$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 |
|----------------------|-------|------|------|------|------|---------|--|
| <b>PG&amp;E</b>      | \$30  | \$25 | \$27 | \$25 | \$48 | \$52.78 | <b>\$208</b>                                 |
| <b>SDG&amp;E</b>     | *     | \$34 | \$21 | \$18 | \$43 | \$43.40 | <b>\$162</b>                                 |
| <b>Southwest Gas</b> | \$22  | \$25 | \$27 | \$28 | \$49 | \$56.35 | <b>\$207</b>                                 |
| <b>SoCalGas</b>      | *     | \$50 | \$26 | \$22 | \$44 | \$50.77 | <b>\$194</b>                                 |

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.

<sup>22</sup> <https://www.cpuc.ca.gov/industries-and-topics/natural-gas/greenhouse-gas-cap-and-trade-program/california-climate-credit>

## 7.2.1 Pacific Gas & Electric

The following pages provide details on the PG&E electricity and natural gas tariffs applied in this study. Table 29 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 29: 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 for G-1 in \$/therm was applied on a monthly basis according to the rates shown in Table 30. 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 30: 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 <sup>1/</sup> Effective April 1, 2022 - Present

BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)

| Individually Metered |   |  |  |
|----------------------|---|--|--|
| Baseline Territories | Summer<br>(April-October)<br>Effective Apr. 1, 2022 | Winter Off-Peak<br>(Nov, Feb, Mar)<br>Effective Nov. 1, 2022 | Winter On-Peak<br>(Dec, Jan)<br>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<br>(April-October)<br>Effective Apr. 1, 2022 | Winter Off-Peak<br>(Nov, Feb, Mar)<br>Effective Nov. 1, 2022 | Winter On-Peak<br>(Dec, Jan)<br>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

Advice Letter: 4589-G  
 Decision 21-11-016  
 GRC 2020 Ph II [Application 19-11-019]  
 Filed: Nov 22, 2019



**Pacific Gas and  
Electric Company**

U 39

Oakland, California

Cancelling Revised

Revised Revised

Cal. P.U.C. Sheet No.  
Cal. P.U.C. Sheet No.

56550-E  
56229-E

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

Sheet 2

RATES:  
(Cont'd.)

**E-TOU-C TOTAL BUNDLED RATES**

| Total Energy Rates (\$ per kWh)  | PEAK        |     | OFF-PEAK    |     |
|--|-------------|-----|-------------|-----|
| <i>Summer</i>  |             |     |             |     |
| Total Usage  | \$0.53933   | (I) | \$0.45589   | (I) |
| Baseline Credit (Applied to Baseline Usage Only)   | (\$0.08851) | (R) | (\$0.08851) | (R) |
| <i>Winter</i>  |             |     |             |     |
| 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)

|          |        |                                    |            |                   |
|----------|--------|------------------------------------|------------|-------------------|
| Advice   | 7009-E | Issued by                          | Submitted  | August 25, 2023   |
| Decision |        | <b>Meredith Allen</b>              | Effective  | September 1, 2023 |
|          |        | Vice President, Regulatory Affairs | Resolution |                   |



**Pacific Gas and  
Electric Company**

U 39

Oakland, California

Cancelling Revised

Cal. P.U.C. Sheet No. 56551-E  
Cal. P.U.C. Sheet No. 56230-E

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

Sheet 3

RATES:  
(Cont'd.)

**UNBUNDLING OF E-TOU-C TOTAL RATES**

| Energy Rates by Component (\$ per kWh)                             | PEAK          | OFF-PEAK        |
|--|---------------|-----------------|
| <b>Generation:</b>   |               |                 |
| Summer (all usage)   | \$0.19776     | \$0.13432       |
| Winter (all usage)   | \$0.14916     | \$0.12413       |
| <b>Distribution**:</b>   |               |                 |
| Summer (all usage)   | \$0.17029 (I) | \$0.15029 (I)   |
| Winter (all usage)   | \$0.11618 (I) | \$0.11286 (I)   |
| <b>Conservation Incentive Adjustment (Baseline Usage)</b>          |               | (\$0.02216) (I) |
| <b>Conservation Incentive Adjustment (Over Baseline Usage)</b>     |               | \$0.06635 (I)   |
| <b>Transmission* (all usage)</b>                                   |               | \$0.05254       |
| <b>Transmission Rate Adjustments* (all usage)</b>                  |               | \$0.00059       |
| <b>Reliability Services* (all usage)</b>                           |               | \$0.00069       |
| <b>Public Purpose Programs (all usage)</b>                         |               | \$0.02578       |
| <b>Nuclear Decommissioning (all usage)</b>                         |               | \$0.00135       |
| <b>Competition Transition Charges (all usage)</b>                  |               | \$0.00030       |
| <b>Energy Cost Recovery Amount (all usage)</b>                     |               | (\$0.00071)     |
| <b>Wildfire Fund Charge (all usage)</b>                            |               | \$0.00530       |
| <b>New System Generation Charge (all usage)**</b>                  |               | \$0.00346       |
| <b>Wildfire Hardening Charge (all usage)</b>                       |               | \$0.00254       |
| <b>Recovery Bond Charge (all usage)</b>                            |               | \$0.00528 (R)   |
| <b>Recovery Bond Credit (all usage)</b>                            |               | (\$0.00528) (I) |
| <b>Bundled Power Charge Indifference Adjustment (all usage)***</b> |               | \$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)

|          |        |                                    |            |                   |
|----------|--------|------------------------------------|------------|-------------------|
| Advice   | 7009-E | Issued by                          | Submitted  | August 25, 2023   |
| Decision |        | Meredith Allen                     | Effective  | September 1, 2023 |
|          |        | Vice President, Regulatory Affairs | Resolution |                   |



**Pacific Gas and  
Electric Company**

U 39

Oakland, California

Revised  
Cancelling Revised

Cal. P.U.C. Sheet No. 56547-E  
Cal. P.U.C. Sheet No. 56226-E

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

|          |        |                                    |            |                   |
|----------|--------|------------------------------------|------------|-------------------|
| Advice   | 7009-E | Issued by                          | Submitted  | August 25, 2023   |
| Decision |        | <b>Meredith Allen</b>              | Effective  | September 1, 2023 |
|          |        | Vice President, Regulatory Affairs | Resolution |                   |



**Pacific Gas and Electric Company**

U 39

San Francisco, California

Cancelling

Revised  
Revised

Cal. P.U.C. Sheet No.  
Cal. P.U.C. Sheet No.

54734-E  
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®**

San Francisco, California

Cancelling  
Revised

Revised  
Revised

Cal. P.U.C. Sheet No.  
Cal. P.U.C. Sheet No.

56208-E  
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<br>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. |        |             |     |

Advice 6968-E  
Decision

Issued by  
**Meredith Allen**  
Vice President, Regulatory Affairs

|            |                      |
|------------|----------------------|
| Submitted  | <u>June 23, 2023</u> |
| Effective  | <u>July 1, 2023</u>  |
| Resolution |                      |

## 7.2.2 Southern California Edison

The following pages provide details on the SCE electricity tariffs applied in this study. Table 31 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 31: 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

- 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  
Cancelling Revised Cal. PUC Sheet No. 74502-E

Schedule TOU-D

Sheet 2

TIME-OF-USE  
DOMESTIC

(Continued)

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:

| Option 4-9 PM / Option 4-9 PM-CPP                         | Delivery Service Total <sup>1</sup> | Generation <sup>2</sup> |                    |
|---|-------------------------------------|-------------------------|--------------------|
|   |                                     | UG <sup>3</sup>         | DWREC <sup>4</sup> |
| 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 <sup>****</sup> - \$/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 <sup>**</sup> - \$/day                     |                                     |                         |                    |
| Single-Family Residence                                   | 0.346                               |                         |                    |
| Multi-Family Residence                                    | 0.346                               |                         |                    |
| Minimum Charge (Medical Baseline) <sup>***</sup> - \$/day |                                     |                         |                    |
| Single-Family Residence                                   | 0.173                               |                         |                    |
| Multi-Family Residence                                    | 0.173                               |                         |                    |
| California Climate Credit <sup>10</sup>                   | (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                               |                                     | (0.15170)               |                    |
| On-Peak Energy Credit - \$/kWh                            |                                     |                         |                    |
| Maximum Available Credit - \$/kWh <sup>****</sup>         |                                     |                         |                    |
| 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.

\*\*\*\* 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)

(To be inserted by utility)

Advice 4929-E

Decision \_\_\_\_\_

2H13

Issued by

Michael Backstrom

Vice President

(To be inserted by Cal. PUC)

Date Submitted Dec 28, 2022

Effective Jan 1, 2023

Resolution E-5217



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

Cancelling

Revised  
Revised

Cal. PUC Sheet No. 86132-E  
Cal. PUC Sheet No. 85624-E

Schedule TOU-D

Sheet 6

TIME-OF-USE

DOMESTIC

(Continued)

RATES (Continued)

|   | Delivery Service<br>Total <sup>1</sup> | Generation <sup>2</sup> |                    |
|---|--|-------------------------|--------------------|
|   |  | UG**                    | DWREC <sup>3</sup> |
| <b>Option PRIME / Option PRIME-CPP</b>  |  |                         |                    |
| 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)                            | 0.38028 (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 <sup>10</sup> | (71.00)                                |                         |                    |
| California Alternate Rates for          |  |                         |                    |
| Energy Discount - %                     | 100.00*                                |                         |                    |
| Family Electric Rate Assistance Discou  | 100.00                                 |                         |                    |
| Medical Line Item Discount - %          | 100.000                                |                         |                    |
| <b>Option PRIME-CPP</b>                 |  |                         |                    |
| 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.

<sup>1</sup> 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.

<sup>2</sup> Generation = The Gen rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.

<sup>3</sup> 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.

<sup>4</sup> Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 5041-E

Decision \_\_\_\_\_

6/19

Issued by

Michael Backstrom

Vice President

(To be inserted by Cal. PUC)

Date Submitted May 30, 2023

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Resolution \_\_\_\_\_



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  
CALIFORNIA ALTERNATE RATES FOR ENERGY  
DOMESTIC SERVICE

Sheet 1

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)

(To be inserted by utility)

Advice 4977-E  
Decision 23-01-002  
TH12 22-12-031

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Resolution \_\_\_\_\_

### 7.2.3 Southern California Gas

Following are the SoCalGas natural gas tariffs applied in this study. Table 32 describes the baseline territories that were assumed for each climate zone.

**Table 32: 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 33. 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.<sup>23</sup> 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 33: 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                    |                 |      |              | Procurement Charge | Transportation Charge | New Rate Effective | New Rate Effective | Absolute Rate Change | % Change |
| Rate Schedule                    |                 |      |              | Charge \$/therm    | Charge \$/therm       | 11/1/2023          | 10/1/2023          |                      |          |
| 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%    |

<sup>23</sup> 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)

## 7.2.4 San Diego Gas & Electric

Following are the SDG&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 \$0.04542/ 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 34: 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 35. 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 35: 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:

| <u>All Customers:</u>             | <u>Daily Therm Allowance</u> |
|-----------------------------------|------------------------------|
| 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

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

**SCHEDULE TOU-DR1**  
**RESIDENTIAL TIME-OF-USE**

Sheet 2

**RATES**

**Total Rates:**

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

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

**Note:**

- 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.
- Total Rates presented are for customers that receive commodity supply and delivery service from Utility.
- DWR-BC and WF-NBC charges do not apply to CARE customers.
- 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.
- WF-NBC rate is 0.00530 + DWR-BC Bond Charge is 0.00000.

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(Continued)

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Advice Ltr. No. 4129-E

Decision No.

Issued by  
**Dan Skopec**  
Senior Vice President  
Regulatory Affairs

Submitted Dec 30, 2022

Effective Jan 1, 2023

Resolution No. E-5217

### 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.;<br>9:00 p.m. - midnight | 6:00 a.m. – 4:00 p.m.<br>Excluding 10:00 a.m. – 2:00 p.m. in March and April;<br>9:00 p.m. - midnight |
| Super Off-Peak                     | Midnight – 6:00 a.m.                           | Midnight – 6:00 a.m.<br>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.;<br>9:00 p.m. - midnight | 2:00 p.m. – 4:00 p.m.;<br>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 |
| <b>Basic Allowance</b>        |  |        |          |        |
| 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   |
| <b>All Electric**</b>         |  |        |          |        |
| 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      |
| <b>Summer</b>                |                |                 |                        |            |
| On-Peak                      | 0.28032        | I 0.00530       | I 0.53067              | I 0.81629  |
| Off-Peak                     | 0.28032        | I 0.00530       | I 0.19567              | I 0.48129  |
| Super Off-Peak               | 0.05588        | I 0.00530       | I 0.09233              | I 0.15351  |
| <b>Winter</b>                |                |                 |                        |            |
| On-Peak                      | 0.28032        | I 0.00530       | I 0.22587              | I 0.51149  |
| Off-Peak                     | 0.28032        | I 0.00530       | I 0.16213              | I 0.44775  |
| Super Off-Peak               | 0.05588        | I 0.00530       | I 0.08402              | I 0.14520  |

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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.

#### 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.;<br>9:00 p.m. – midnight | 6:00 a.m. – 4:00 p.m.<br>Excluding 10:00 a.m.–2:00 p.m. in March and April;<br>9:00 p.m. – midnight |
| Super-Off-Peak        | Midnight – 6:00 a.m.                           | Midnight – 6:00 a.m.<br>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.;<br>9:00 p.m. – midnight | 2:00 p.m. – 4:00 p.m.<br>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)

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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 |
|---------------------------|------------|------------|------------|------------|--------------|-----------------|
| <b>Effective Discount</b> | <b>40%</b> | <b>39%</b> | <b>38%</b> | <b>38%</b> | <b>36% R</b> | <b>35%</b>      |

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

(Continued)

1C5

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Vice President

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## 7.2.5 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 36. 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 36: CPAU Monthly Gas Rate (\$/therm)**

| Month     | G1<br>Volumetric<br>Total<br>Baseline | G1<br>Volumetric<br>Total<br>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:

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

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



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

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

##### B. Optional Critical Peak Pricing Rate

- 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.).
- The CPP Rate provides a discount per kWh on the Mid-Peak and Off-Peak prices during summer months.
- 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](http://www.smud.org).
- 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](http://www.smud.org).
- The CPP Rate Event Price and discount will be updated annually at SMUD's discretion and posted on [www.smud.org](http://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

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

SACRAMENTO MUNICIPAL UTILITY DISTRICT  
 Resolution No. 23-09-09 adopted September 21, 2023

Sheet No. **R-TOD-2**  
 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<br>(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 <sup>1</sup> .  |
| Non-Summer<br>(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 <sup>1</sup> .  |

<sup>1</sup> See Section V. Conditions of Service

## 7.2.7 Fuel Escalation Assumptions

The average annual escalation rates in Table 37 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 38 presents the average annual escalation rates used in the utility rate escalation sensitivity analysis shown in Section 4.6.3. 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.<sup>24</sup> 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 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 37: Real Utility Rate Escalation Rate Assumptions, CPUC En Banc and 2022 TDV Basis**

| Year | 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%  |

<sup>24</sup> <https://www.energy.ca.gov/files/2025-energy-code-hourly-factors>. Actual escalation factors were provided by consultant F53.

**Table 38: 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%  |

## 7.3 Summary of Efficiency Measures

Table 39 provides the details of the efficiency (non-preempted) measures, by climate zone, included in the following packages for the single family prototype:

- Efficiency Only
- Efficiency + High Efficiency (Preempted) Equipment
- Efficiency + PV
- Efficiency + PV + Battery (all-electric only)

The efficiency measures for the single family mixed fuel Efficiency + PV + Battery package is presented in Table 40, and Table 41 presents the efficiency measures for all the ADU packages. In all tables, the lack of an “X” indicates that the prescriptive values for that climate zone were not changed. See Appendix 7.4 for a list of prescriptive values by climate zone. Efficiency measures are described in Section 3.3.1.

**Table 39: All-Electric Single Family Efficiency Measures, Various Packages**

| Climate Zone | 3 ACH50 | R-10 Slab | Attic Ceiling Insulation | 0.25 Roof Solar Reflectance | 0.24 U-Factor / 0.50 SHGC Windows | 0.35 W/cfm | Buried Ducts | Basic Compact Hot Water Credit |
|--------------|---------|-----------|--------------------------|-----------------------------|-----------------------------------|------------|--------------|--------------------------------|
| 1            |         | X         | R-60                     |                             |                                   |            | X            |                                |
| 2            |         | X         | R-60                     |                             |                                   | X          | X            | X                              |
| 3            |         |           | R-60                     |                             |                                   | X          | X            | X                              |
| 4            |         | X         | R-60                     |                             |                                   | X          | X            | X                              |
| 5            |         |           | R-49                     |                             |                                   | X          | X            | X                              |
| 6            |         |           | R-60                     |                             |                                   | X          | X            | X                              |
| 7            |         |           | R-49                     |                             |                                   |            | X            | X                              |
| 8            |         |           | R-60                     |                             |                                   | X          | X            | X                              |
| 9            |         |           | R-60                     |                             |                                   | X          | X            | X                              |
| 10           |         |           | R-60                     | X                           |                                   | X          | X            | X                              |
| 11           |         | X         | R-60                     | X                           |                                   | X          | X            | X                              |
| 12           |         | X         | R-60                     | X                           |                                   | X          | X            | X                              |
| 13           |         | X         | R-60                     | X                           |                                   | X          | X            | X                              |
| 14           | X       | X         | R-60                     | X                           |                                   | X          | X            | X                              |
| 15           |         | X         | R-60                     | X                           |                                   | X          | X            | X                              |
| 16           |         |           | R-60                     |                             | X                                 | X          | X            |                                |

Table 40: Mixed Fuel Single Family Measures, Efficiency + PV + Battery Package<sup>25</sup>

| Climate Zone | 3 ACH50 | R-10 Slab | Attic | 0.25 Roof Solar Reflectance | 0.24 U-Factor / 0.50 SHGC Windows | 0.30 U-Factor / 0.50 SHGC Windows | 0.35 W/cfm | Buried Ducts | Basic Compact Hot Water Credit |
|--------------|---------|-----------|-------|-----------------------------|-----------------------------------|-----------------------------------|------------|--------------|--------------------------------|
| 1            |         | X         |       |                             |                                   | X                                 |            | X            |                                |
| 2            |         | X         | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 3            |         |           | R-38  |                             |                                   | X                                 |            | X            | X                              |
| 4            |         | X         | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 5            |         | X         | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 6            |         |           | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 7            |         |           | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 8            |         |           | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 9            |         |           | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 10           |         |           | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 11           |         |           | R-49  |                             |                                   |                                   | X          | X            | X                              |
| 12           |         |           | R-49  | X                           |                                   |                                   | X          | X            | X                              |
| 13           |         |           | R-49  | X                           |                                   |                                   | X          | X            | X                              |
| 14           |         | X         | R-49  | X                           |                                   |                                   | X          | X            | X                              |
| 15           |         | X         | R-49  | X                           |                                   |                                   | X          | X            | X                              |
| 16           |         |           | R-49  |                             | X                                 |                                   | X          | X            |                                |

Table 41: Efficiency Measures for All ADU Packages

| Climate Zone | 3 ACH50 | R-10 Slab | 0.25 Roof Solar Reflectance | 0.24 U-Factor / 0.50 SHGC Windows | Ductless VCHP <sup>1</sup> | Basic Compact Hot Water Credit <sup>1</sup> |
|--------------|---------|-----------|-----------------------------|-----------------------------------|----------------------------|---|
| 1            |         | X         |                             |                                   | X                          |   |
| 2            |         | X         |                             |                                   | X                          | X   |
| 3            |         |           |                             |                                   | X                          | X   |
| 4            |         | X         |                             |                                   | X                          | X   |
| 5            |         |           |                             |                                   | X                          | X   |
| 6            |         |           |                             |                                   | X                          | X   |
| 7            |         |           |                             |                                   | X                          | X   |
| 8            |         |           |                             |                                   | X                          | X   |
| 9            |         |           |                             |                                   | X                          | X   |
| 10           |         |           | X                           |                                   | X                          | X   |
| 11           |         | X         | X                           |                                   | X                          | X   |
| 12           |         | X         | X                           |                                   | X                          | X   |
| 13           |         | X         | X                           |                                   | X                          | X   |
| 14           | X       | X         | X                           |                                   | X                          | X   |
| 15           |         | X         | X                           |                                   | X                          | X   |
| 16           |         |           |                             | X                                 | X                          |   |

<sup>1</sup> The ductless VCHP and compact hot water measures are only applied to the all-electric packages and not the mixed fuel packages.

<sup>25</sup> The efficiency measures for the all-electric version of this package follow those listed in Table 39.

## 7.4 Summary of Applicable Prescriptive Base Case Measures

This appendix lists the prescriptive values, by climate zone, of building components relevant to the measures included in this analysis. Table 42 outlines envelope, PV, and battery values;

Table 43 outlines space conditioning values, and Table 44 outlines domestic water heating (DHW) values.

**Table 42 Prescriptive Envelope, PV, and Battery Measures by Climate Zone**

| CZ | Air Infiltration <sup>1</sup> | Foundation               | Wall Insulation <sup>2</sup> | Attic Insulation <sup>3</sup> | Roof Aged Solar Reflectivity | Window U-Factor / SHGC | PV <sup>4</sup> | Battery |
|----|-------------------------------|--------------------------|------------------------------|-------------------------------|------------------------------|------------------------|-----------------|---------|
| 1  | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38                          | 0.1                          | 0.30 / 0.35            | code min.       | none    |
| 2  | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38                          | 0.1                          | 0.30 / 0.23            | code min.       | none    |
| 3  | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-30                          | 0.1                          | 0.30 / 0.35            | code min.       | none    |
| 4  | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.1                          | 0.30 / 0.23            | code min.       | none    |
| 5  | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-30                          | 0.1                          | 0.30 / 0.35            | code min.       | none    |
| 6  | 5 ACH50                       | Uninsulated slab         | R-15 + R-4                   | R-30                          | 0.1                          | 0.30 / 0.23            | code min.       | none    |
| 7  | 5 ACH50                       | Uninsulated slab         | R-15 + R-4                   | R-30                          | 0.1                          | 0.30 / 0.23            | code min.       | none    |
| 8  | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.1                          | 0.30 / 0.23            | code min.       | none    |
| 9  | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.1                          | 0.30 / 0.23            | code min.       | none    |
| 10 | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.2                          | 0.30 / 0.23            | code min.       | none    |
| 11 | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.2                          | 0.30 / 0.23            | code min.       | none    |
| 12 | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.2                          | 0.30 / 0.23            | code min.       | none    |
| 13 | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.2                          | 0.30 / 0.23            | code min.       | none    |
| 14 | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.2                          | 0.30 / 0.23            | code min.       | none    |
| 15 | 5 ACH50                       | Uninsulated slab         | R-21 + R-5                   | R-38 + R-19                   | 0.2                          | 0.30 / 0.23            | code min.       | none    |
| 16 | 5 ACH50                       | R-7, 16" slab insulation | R-21 + R-5                   | R-38 + R-19                   | 0.1                          | 0.30 / 0.35            | code min.       | none    |

<sup>1</sup> 5 ACH50 is prescriptively required however verification is not required.

<sup>2</sup> Cavity wall insulation + continuous rigid insulation.

<sup>3</sup> Ceiling/attic insulation R-value. R-38 + R-19 reflect High Performance Attics (HPAs) as defined by Option B in Table 150.1-A.

<sup>4</sup> Prescriptive PV capacities (kW-DC) by climate zone are summarized in Table 4.

Table 43 Prescriptive HVAC Measures by Climate Zone

| CZ | Heating Type | AC Type   | Heating Efficiency <sup>1</sup> | HVAC Efficiency (SEER2/EER2) | HVAC Fan Efficacy (W/cfm) | Ducts <sup>2</sup>             |
|----|--------------|-----------|---------------------------------|------------------------------|---------------------------|--------------------------------|
| 1  | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 2  | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 3  | Heat pump    | Heat pump | 7.5                             | 14.3 / 11.7                  | 0.45                      | R-6, 5%, in attic (not buried) |
| 4  | Heat pump    | Heat pump | 7.5                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 5  | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-6, 5%, in attic (not buried) |
| 6  | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-6, 5%, in attic (not buried) |
| 7  | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-6, 5%, in attic (not buried) |
| 8  | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 9  | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 10 | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 11 | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 12 | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 13 | Heat pump    | Heat pump | 7.5                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 14 | Heat pump    | Heat pump | 7.5                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 15 | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |
| 16 | Gas Furnace  | AC        | 80%                             | 14.3 / 11.7                  | 0.45                      | R-8, 5%, in attic (not buried) |

<sup>1</sup> AFUE for gas furnaces, HSPF2 for heat pumps.<sup>2</sup> Duct insulation R-value, duct leakage, duct location.

Table 44 Prescriptive Water Heating Measures by Climate Zone

| CZ | DHW Type     | DHW Location  |  | DHW: Basic Compact Distribution Credit |
|----|--------------|---------------|--|--|
|    |              | Single Family | ADU  |  |
| 1  | Heat pump    | Garage        | In conditioned space, ducted to/from outside | Yes                                    |
| 2  | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 3  | Gas tankless | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 4  | Gas tankless | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 5  | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 6  | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 7  | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 8  | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 9  | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 10 | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 11 | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 12 | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 13 | Gas tankless | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 14 | Gas tankless | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 15 | Heat pump    | Garage        | In conditioned space, ducted to/from outside | No                                     |
| 16 | Heat pump    | Garage        | In conditioned space, ducted to/from outside | Yes                                    |

## 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.



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2022 Code:

# Nonresidential New Construction Reach Code Cost-effectiveness Study

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## Acronym List

- AC – Air Conditioner
- ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
- B/C – Benefit-to-Cost Ratio
- BOD – Basis of Design
- BSC – Building Standards Commission
- Btu – British thermal unit
- CAV – Constant Air Volume
- CBECC - California Building Energy Code Compliance
- CBECS - Commercial Building Energy Consumption Survey
- CBSC - California Building Standards Commission
- CEC - California Energy Commission
- CPAU – City of Palo Alto Utilities
- CZ – Climate Zone
- DCKV – Demand-Controlled Kitchen Ventilation
- DHW – Domestic Hot Water
- DEER – Database for Energy Efficient Resources
- DOE – U.S. Department of Energy
- E3 – Energy and Environmental Economics
- EUI – Energy Use Index
- FDD – Fault Detection and Diagnostics
- GHG - Greenhouse Gas
- GPM – Gallons Per Minute
- HVAC – Heating, Ventilation, and Air Conditioning
- IOU – Investor-Owned Utility



- kWh – Kilowatt Hour
- LADWP – Los Angeles Department of Water and Power
- LBNL – Lawrence Berkeley National Lab
- LPD – Lighting Power Density
- NPV – Net Present Value
- QSR – Quick-Service Restaurant
- PNNL – Pacific Northwest National Laboratory
- POU – Publicly Owned Utility
- PTHP – Packaged Terminal Heat Pump
- PG&E – Pacific Gas & Electric (utility)
- PTAC – Packaged Terminal Air Conditioning
- PV - Solar Photovoltaic
- SCE – Southern California Edison (utility)
- SCG – Southern California Gas (utility)
- SDG&E – San Diego Gas & Electric (utility)
- SHW – Service Hot Water
- SMUD – Sacramento Municipal Utility District
- SZ – Single Zone
- TDV – Time Dependent Valuation
- VAV – Variable Air Volume
- TDV - Time Dependent Valuation
- Title 24 – California Code of Regulations Title 24, Part 6
- TOU – Time of Use

| Summary of Revisions |   |                             |
|----------------------|---|-----------------------------|
| Date                 | Description   | Reference (page or section) |
| 11/16/2022           | Original Release  | -                           |
| 01/31/2023           | Minor changes to reflect efficiency compliance margin calculation updates in workbook and report tables | Section 5                   |
| 03/24/2023           | Minor changes in narrative of quick service restaurant in reach code considerations                     | Section 5                   |

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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, also known as a reach code, intended to support meeting local and/or statewide energy efficiency and greenhouse gas (GHG) reduction goals. The program facilitates the adoption and implementation of reach codes when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

The Reach Code Team (the Team) provides this report and accompanying Reach Code Results Workbook to present measures and measure packages that local jurisdictions can adopt to achieve energy savings and emissions reductions beyond what will be accomplished by enforcing the minimum state requirements according to the 2022 Building Energy Efficiency Standards (Title 24, Part 6), effective January 1, 2023. This report documents a variety of above-code electrification, energy efficiency, load flexibility, and solar photovoltaic (PV) packages applied to a set of four nonresidential building prototypes: Medium Office, Standalone Retail, Quick-Service Restaurant, and Small Hotel.

The Team evaluated energy simulation results and code compliance using the CBECC v1.0 software version released in June 2022. Results may change with future software versions. Results across all prototypes indicate the efficiency measures included in the analysis, both On-Bill and TDV, are cost-effective across all climate zones when added to the prescriptive baseline prototype. In all cases all-electric packages are capable of achieving the greatest greenhouse gas emissions reductions as compared to mixed-fuel buildings.

These results, including the attached Reach Code Results Workbook, indicate that all-electric packages can achieve the greatest greenhouse gas emissions reductions as compared to mixed-fuel buildings. Results align with the decarbonization objectives set by California Energy Commission (Energy Commission), and several new construction ordinances focusing on all-electric design. The results of this study by prototype are summarized below:



**Medium Office:** Due to the lack of a prescriptive compliance pathway and performance modeling approach in CBECC, all-electric space heating is simulated as electric-resistance variable-air-volume reheat. This system selection limits operational benefits, energy code compliance, and cost-effectiveness. All-electric packages are cost-effective with energy efficiency and load flexibility measures in many climate zones, but do not achieve code compliance across all three metrics—with efficiency TDV margin being the most challenging. Results will be updated in the first half of 2023 when central heat pump boilers can be simulated in CBECC. Jurisdictions may adopt reach codes that exempt building systems that do not have a prescriptive pathway in the energy code and cannot be modeled to comply using the performance approach. Efficiency packages over the mixed-fuel baseline are cost-effective and compliant across all climate zones.



**Medium Retail:** All-electric is prescriptively required in most scenarios in Retail buildings. The Team identified cost-effective and code compliant packages with energy efficiency measures over an all-electric baseline in most climate zones. This study analyzed mixed-fuel retail buildings with large (>240 kBtuh) gas furnace packaged units replacing the smaller (<240 kBtuh) packaged heat pumps. The mixed-fuel building is neither cost-effective nor code compliant in most climate zones.



**Quick-Service Restaurant:** The Team identified cost-effective, *nearly* cost-effective, and code compliant packages in several climate zones for all-electric space conditioning and service water heating when including energy efficiency and solar PV measures. The Team could not identify cost-effective packages including all-electric commercial cooking equipment except for City of Palo Alto Utility (CPAU) territory. Also, when including energy efficiency measures, restaurants with all-electric cooking achieve compliance and are *nearly* On-Bill cost-effective in Sacramento Municipal Utility District (SMUD) territory as well. Jurisdictions may adopt All-Electric reach codes that exempt commercial cooking equipment or require energy efficiency for either mixed-fuel and/or all-electric buildings, in many climate zones.



**Small Hotel:** All-electric packages are cost-effective and code-compliant in most climate zones. The remaining climate zones are very close to meeting the TDV Efficiency compliance criteria and may achieve compliance by re-evaluating nonresidential-area modeling using central heat pump boiler instead of electric resistance VAV systems. In addition to electrification packages that include single-zone packaged heat pumps, the Team analyzed an alternative scenario with packaged terminal heat pumps (PTHPs) that improved all-electric code minimum cost-effectiveness due to high first-cost savings, but PTHPs do not achieve TDV Efficiency compliance. Mixed-fuel plus energy efficiency is code compliant and cost-effective across all climate zones.

Jurisdictions may use these results for amending Part 6, Part 11, other parts of the California building code, or their municipal code as determined appropriate for the given jurisdiction. A cost-effectiveness study is required to amend Part 6 of the California building code or when adopting energy efficiency or energy conservation measures, including solar PV or batteries. The Energy Commission has previously concluded that all-electric requirements do not constitute an energy efficiency or energy conservation standard and are outside the scope of Public Resources Code section 25402.1(h)(2).<sup>1</sup> Jurisdictions may adopt an All-Electric reach code when amending Part 11 or their municipal code. Even reach code policies that only require electrification, and do not require energy efficiency or conservation, will benefit from findings in this study to inform potential economic impacts of a policy decision. This study documents the estimated costs, benefits, energy impacts and GHG 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.

Model ordinance language and other resources are posted on the C&S Reach Codes Program website at [www.localenergycodes.com](http://www.localenergycodes.com). Local jurisdictions that are considering adopting an ordinance are encouraged to contact the program for further technical support at [info@localenergycodes.com](mailto:info@localenergycodes.com).

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<sup>1</sup> CEC Letter to South San Francisco 2021: <https://bayareareachcodes.org/wp-content/uploads/2022/10/CEC-Letter-to-SSF-Signed.pdf>

# 1 Introduction

This report documents cost-effective combinations of measures that exceed the minimum state requirements, the 2022 California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (CEC 2022), effective January 1, 2023, for newly constructed nonresidential buildings. This report was developed in coordination with the California Statewide Investor-Owned Utilities (CA IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Reach Code Team (or “the Team” for short). The objectives of this report are to inform discourse for local reach code adoption and, where applicable, support approval of local energy code amendments from the California Energy Commission (the Energy Commission).

The Reach Code Team performed cost-effectiveness analysis for the following scenarios above prescriptive 2022 Title 24 code requirements in all 16 California climate zones (CZs):

- Fuel substitution with federal code-minimum efficiency appliances, compared to a prescriptive minimum design compliance pathway.
  - For the retail building type, the prescriptive code minimum is all-electric. Fuel substitution packages revert to mixed-fuel appliances.
  - For all other building types, the prescriptive code minimum is mixed-fuel. Fuel substitution packages switch to all-electric appliances.
- Energy efficiency measures
- Load flexibility measures
- Solar PV and Battery

The Reach Code Team analyzed four prototypes—Medium Office, Medium Retail, Quick-Service Restaurant, and Small Hotel—to represent common nonresidential new construction buildings in the California. The selected building types align with the requests received from dozens of jurisdictions seeking to adopt reach codes. The results of this cost-effectiveness study could potentially be extrapolated to other building types that have similar properties such as occupancy pattern, HVAC design and layout. These results were attained using the first version of California Building Energy Compliance Calculator (CBECC) software that is approved by CEC for 2022 code compliance. There are a few gaps in functionalities and standard design assumptions in this software version, described in Section 2.5, the Reach Code team has been actively coordinating with the CBECC software team to inform future software updates.

Title 24 is maintained and updated every three years by two state agencies: 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). When adopting local energy efficiency or conservation ordinances, 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 formal approval from the Energy Commission and file the ordinance with the BSC for the ordinance to be legally enforceable. Local jurisdictions do not require Energy Commission approval when adopting ordinances that do not require efficiency or conservation, such as only electrification-required ordinances.

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 equipment 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 measures 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.

This study references the statewide reach code study performed in 2019 for newly constructed nonresidential buildings as a starting point for additional measure definitions. Importantly, the current 2022 cost-effectiveness report introduced a new restaurant building type and updated the modeling and cost assumptions.

## 2 Methodology and Assumptions

The Reach Code Team analyzed four prototypes—Medium Office, Medium Retail, Quick-Service Restaurant, and Small Hotel—using the cost-effectiveness methodology detailed in this section below.

### 2.1 Cost-effectiveness

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

#### 2.1.1 Benefits

This analysis used both On-Bill and time dependent valuation (TDV) of energy-based approaches to evaluate cost-effectiveness. Both On-Bill and TDV require estimating and quantifying the energy savings and costs associated with energy measures. The primary difference between On-Bill and TDV is how energy is valued:

- **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 15-year duration accounting for a three percent discount rate and energy cost inflation per Appendix 8.2.
- **TDV:** TDV was developed by the Energy Commission to reflect the time dependent value of energy, including long-term projected costs of energy such as the cost of providing energy during peak periods of demand and other societal costs including projected costs for carbon emissions and grid transmission impacts. This metric values energy uses differently depending on the fuel source (gas, electricity, and propane), time of day, and season. Electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods. This refers to the “Total TDV” that includes all the energy end uses such as space-conditioning, mechanical ventilation, service water heating indoor lighting, photovoltaic (PV) and battery storage systems, and covered process loads.

#### 2.1.2 Costs

The Reach Code Team assessed the incremental costs and savings of the energy packages over a 15 year lifecycle. Incremental costs represent the equipment, installation, replacements, and maintenance costs of the proposed measure relative to the 2022 Title 24 standards minimum requirements or standard industry practices. The Reach Code Team obtained baseline and measure costs from manufacturer distributors, contractors, literature review, and online sources such as RS Means.

For heating, ventilation, and air conditioning (HVAC) and water heating baseline and measure costs, including gas and electrical infrastructure, the Reach Code Team contracted two different firms, one mechanical contractor (Western Allied Mechanical, based in Menlo Park) and one mechanical designer (P2S Engineering, based in Irvine) to provide cost data. The Reach Code Team developed a basis of design for all prototypes described in section 3.1 and worked with the mechanical contractor and designer to get cost estimates. The Reach Code Team determined HVAC design heating and cooling loads and capacities by climate zone from the energy models. For each HVAC system type, the Reach Code Team requested costs for the smallest capacity unit required and the largest capacity unit required and specified federal minimum equipment efficiency.

The mechanical contractor and mechanical designer collected equipment costs and labor assumptions from their vendors and manufacturers’ representatives, as well as through their own recent projects. The mechanical contractor and designer provided material and labor cost estimates for the entire HVAC and DHW systems, disaggregated by the HVAC and DHW equipment itself; refrigerant piping; structural; electrical supply; gas supply; controls; commissioning and startup; general conditions and overhead; design and engineering; permit, testing, and inspection; and a contractor profit or market factor. The mechanical contractor and designer provided costs for each of the system capacities, based on which the Reach Code Team developed a relationship between HVAC system capacity and cost to calculate the cost for each building in each climate zone. In most cases, the analysis uses the average of the costs provided by

the contractor and the costs provided by the designer. In some limited cases where costs provided by one source were unlikely to be representative of the measure, costs from only the other source were used. The Reach Code Team added taxes, contractor markups, maintenance costs, and replacement costs where needed, and adjusted material and labor costs for each climate zone based on weighting factors from RS Means (presented in Appendix 8.3).

Actual project costs vary widely based on a range of real-building considerations. The costs that the Reach Code Team determined through contractors are likely costs for the given prototypes and are not representative of all projects.

### 2.1.3 Metrics

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

- **NPV:** Net savings (NPV benefits minus NPV costs). If the net savings of a measure or package is positive over a lifetime of 15 years, 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 incremental costs to implement the measure (i.e., construction and maintenance cost savings) outweigh the negative energy cost impacts.
- **B/C Ratio:** Ratio of the present value of all benefits to the present value of all costs over 15 years (NPV benefits divided by NPV costs). The criterion for cost-effectiveness is a B/C greater than 1.0. A value of one indicates the savings over the life of the measure are equivalent to the incremental cost of that measure. A value greater than one represents a positive return on investment.

Improving the energy performance of a building often requires an initial capital investment, though in some cases an energy measure may be cost neutral or have a lower cost. In most cases the benefit is represented by annual On-Bill utility or TDV savings and the cost by incremental first cost and replacement costs. 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., shows positive upfront construction cost savings and lifetime energy cost savings), B/C ratio cost-effectiveness is represented by ">1". Because of these situations, NPV savings are also reported, which, in these cases, are positive values.

### 2.1.4 Utility Rates

In coordination with the IOU and POU rate teams the Reach Code Team determined appropriate utility rates for each CZ and package as of October 2022. The utility tariffs, summarized in Table 1, were determined based on the annual load profile of each prototype and the corresponding package, the most prevalent rate in each utility territory, and information indicating that the rates were unlikely to be phased out during the code cycle.

A time-of-use (TOU) rate was applied to most cases, some POUs may not have TOU rates. In addition to energy consumption charges, there are kW demand charges for monthly peak loads. Utilities calculate the peak load by the highest kW of the 15-minute interval readings in the month. However, the energy modeling software produces results on hourly intervals; hence, the Team calculated the demand charges by multiplying the highest load of all hourly loads in a month with the corresponding demand charge per kW. The utility rates applicable to a prototype may vary by package and CZ especially between a mixed fuel and all-electric package if the monthly peak demand loads exceed the applicable threshold.

The Reach Code Team coordinated with utilities to select tariffs for each prototype given the annual energy demand profile of each specific prototype, climate zone, and measure package and the most prevalent rates in each utility territory. The Reach Code Team did not compare a variety of tariffs to determine their impact on cost-effectiveness. Utility rate updates can affect cost-effectiveness results. For a more detailed breakdown of the rates selected, refer to Appendix 8.2.

For packages with PV generation, the approved Net Energy Metering (NEM) 2.0 tariffs were applied along with minimum daily use billing and mandatory non-bypassable charges. For the PV cases, annual electric production was always less than the modeled annual electricity consumption; therefore, no credits for surplus generation were necessary.

The analysis assumes that utility rates escalate over time for commercial buildings, as described in Appendix 8.2. Escalation rates above inflation for electricity beyond 2023 are assumed to be between 0.2% and 0.7%, before dropping to a steady 0.6% escalation per year in 2030. Natural gas is assumed to escalate at a relatively higher rate, peaking at 7.7% in 2024, then escalating more slowly to a rate of approximately 2% in the latter years of the analysis period.

**Table 1. Utility Tariffs Used Based on CZ (October 2022)**

| CZs                             | Electric / Gas Utility   | Electricity                    | Natural Gas  |
|---------------------------------|--|--------------------------------|--------------|
| <b>Investor-Owned Utilities</b> |  |                                |              |
| 1-5,11-13,16                    | Pacific Gas & Electric Company (PG&E)                            | B-1 / B-10                     | G-NR1        |
| 6, 8-10, 14, 15                 | Southern California Edison (SCE) / Southern California Gas (SCG) | TOU-GS-1 / TOU-GS-2 / TOU-GS-3 | G-10 (GN-10) |
| 7, 10, 14                       | San Diego Gas and Electric Company (SDG&E)                       | AL-TOU + EECC (AL-TOU)         | GN-3         |
| <b>Publicly Owned Utilities</b> |  |                                |              |
| 4                               | City of Palo Alto Utilities (CPAU)                               | E-2                            | G-2          |
| 12                              | Sacramento Municipal Utilities District (SMUD)                   | CI-TOD 1 (CITS-0 /CITS-1)      | G-NR1        |

## 2.2 Energy Simulations

The Reach Code Team performed energy simulations using California's Building Energy Code Compliance Software CBECC 2022.1.0 (1250) with ruleset version BEMCmpMgr 2022.1.0 (7361) (California Building Energy Code Compliance 2022).<sup>2</sup> This is the first 2022 Title 24 code compliance software approved by Energy Commission for compliance of nonresidential buildings on June 8, 2022. The CBECC software combined the capabilities of CBECC-Com and CBECC-Res software into one to model both nonresidential and multifamily building prototypes in one interface.

The Reach Code Team set up parametric simulations using Modelkit software to run thousands of measure packages for each prototype in all California's CZs. Individual measures were simulated separately and combined into cost-effective measure packages for each CZ. Where necessary, the Reach Code Team employed minor ruleset changes, such as load flexibility measures that alter thermostat setpoint schedules, to improve the cost-effectiveness of measure packages. While these measures produce operational savings, they may not be used to achieve code compliance without further software upgrades.

## 2.3 2022 T24 Compliance Metrics

2022 Title 24 Section 140.1 defines the energy budget of the building based on source energy and TDV energy for space-conditioning, indoor lighting, mechanical ventilation, photovoltaic (PV) and battery storage systems, and service

<sup>2</sup> Prior to the CBECC software, the Reach Code Team used CBECC-Com 2022 and CBECC 2022.0.8 Beta to model nonresidential prototypes for the 2022 reach code analysis. The Reach Code Team noted the changes in results due to updates in functionalities and standard design assumptions.

water heating and covered process loads. CEC has introduced two new compliance metrics in addition to Total Compliance TDV Margin for 2022 code cycle. A building needs to comply with all three compliance metrics below:

- **Efficiency TDV.** Efficiency TDV accounts for all regulated end-uses but does not include the impacts of PV and battery storage.
- **Total TDV.** Total TDV Compliance metric includes regulated end-uses accounting for PV and battery storage contributions.
- **Source Energy.** Source energy is based on fuel used for power generation, assuming utilities meet all Renewable Portfolio Standard (RPS) goals and other obligations projected over 15-year lifecycle.

## 2.4 GHG Emissions

The analysis uses the GHG emissions estimates built into CBECC. The GHG emission multipliers were developed by Energy + Environmental Economics (E3) to support development of compliance metrics for use in the 2022 California energy code (E3 2021). There are 8,760 hourly multipliers accounting for time dependent energy use and carbon emissions based on source emissions, including RPS projections. For the 2022 code cycle, the multipliers incorporate GHG from methane and refrigerant leakage, which are two significant sources of GHG emissions (NORESO 2020). There are 32 strings of multipliers, with a different string for each California CZ and each fuel type (metric tons of CO<sub>2</sub> per kWh for electricity and metric tons of CO<sub>2</sub> per therm for natural gas).

## 2.5 Limitations and Further Considerations

The Team encountered some modeling limitations, outside of the Team's control that should be noted while using these results to inform reach code policies,

- **CBECC Software:**
  - The Reach Code Team coordinated with the CBECC software development team on potential differences in our understanding of 2022 code requirements and its implementation in standard design such as battery controls. The version of 2022 CBECC software v1.0, described in Section 2.2, available to the Reach Code Team at the time of the analysis has limited functionalities and could not model heat pump hydronic system or other measures like drain water heat recovery. As the software evolves, some results may look different.
  - The most likely all-electric replacement for a central gas boiler serving a variable air volume reheat system would be a central heat pump boiler; however, this system cannot be modeled in CBECC at the time of the writing of this report. The Reach Code Team is treating this analysis as temporary until a compliance pathway is established for a central heat pump boiler in the Energy Code and results can be updated accordingly.
  - The team identified some apparent anomalies in software-reported compliance margins when they became available in June 2022. The Reach Code Team is in the midst of discussing outputs and ramifications with software development team specifically related to ventilation such as fan power and heat recovery, among other modeling methods. Results may change with future software versions. In the interim, the Reach Code Team manually calculated the compliance margins using the mixed fuel baseline model created in this study based on our best understanding.
- **Prototype Building:** The cost-effectiveness analysis is based on standard prototypical buildings, which may differ from actual buildings being constructed. Jurisdictions should keep this in mind while extrapolating to the buildings in their territory.

- **System Cost Assumptions:** The incremental electrification and additional measure costs are based on specific system selection and assumptions made by experienced professionals. These costs can vary based on contractor, system design and specifications, and regional variation.

The Team will re-evaluate packages with central heat pump boiler system in Medium Office and Small Hotel in early 2023. In addition to the packages assessed in the report, there are other future potential enhancements that can be considered for more cost-effective or compliant packages:

- Adding more solar PV than already analyzed if the building has more roof space to accommodate.
- Adding battery at higher levels than prescriptively required in 2022 Title 24 with more advanced controls.
- Adding energy efficiency measures as software capability evolves such as drain water heat recovery.
- Applying federally pre-emptive (high) efficiency energy systems or appliances.

### 3 Prototypes, Measure Packages, and Costs

This section describes the prototype characteristics and the scope of analysis including measures and their corresponding costs. The Reach Code Team used versions of the following four DOE building prototypes to evaluate cost-effectiveness of measure packages in the occupancy types listed below:

- Medium Office
- Medium Retail
- Quick-Service Restaurant (QSR)
- Small Hotel

The Reach Code Team designed the baseline prototypes to be mixed fuel based on 2022 Title 24 Final Express Terms requirements. The Reach Code Team reviewed the 2022 T24 ACM HVAC system map to ensure alignment as applicable for most cases, differences if any are discussed in subsequent sections. The Team built new construction prototypes to have compliance margins as close to zero as possible to reflect a prescriptively compliant new construction building in each CZ. The code compliance is based on the first publicly available CBECC v1.0 compliance software as described in Section 2.2. Misalignments have been reported back to the software team for future software iterations, as described in Section 2.5.

#### 3.1 Prototype Characteristics

The DOE provides building prototype models which, when modified to comply with 2022 Title 24 requirements, can be used to evaluate the cost-effectiveness of efficiency measures (U.S. Department of Energy 2022 A). These prototypes have historically been used by the Energy Commission to assess potential code enhancements. The selection of four building types for this analysis is based on the priority suggested by a group of California cities. The cost-effectiveness results of this study could potentially be extrapolated to other building types that have similar properties such as occupancy pattern, HVAC design and layout.

Water heating includes both service hot water (SHW) for office and retail buildings and domestic hot water for hotel guest rooms. In this report, water heating or SHW is used to refer to both. The compliance software assumes a Standard Design, where HVAC and SHW systems are based on the system maps included in 2022 Nonresidential ACM Reference Manual. However, the Reach Code Team applied both 2022 Title 24 prescriptive requirements and 2022 ACM system map for baseline mixed fuel model, HVAC and SHW system characteristics as described below.

- **Medium Office**
  - The HVAC design is a variable air volume (VAV) reheat system with two gas hot water boilers, three packaged rooftop units (one serving each floor), and VAV terminal units with hot water reheat coils.
  - The SHW design includes one 8.7 kW electric resistance hot water heater with a 5-gallon storage tank.
- **Medium Retail**
  - For CZs 2 to 15, the 2022 Title 24 ACM System Map Standard Design informed the baseline model to have three packaged Single Zone Heat Pump (SZHP) systems for the smaller capacity (<240 kBtuh) thermal zones, in alignment with 2022 Title 24 prescriptive code requirements.<sup>3</sup> The large (>240 kBtuh) core thermal zone has two smaller (<240 kBtuh) SZHPs with VAV fans instead of one large SZHP, since larger rooftop packaged heat pumps are not available in the market. The 2022 Title24 ACM Standard Design assumes a large SZHP for larger zones as well, however this deviation does not impact the results considerably.<sup>3</sup>

<sup>3</sup> <https://www.energy.ca.gov/publications/2022/2022-nonresidential-and-multifamily-alternative-calculation-method-reference>

- For CZs 1 and 16, the baseline model assumed all-electric packaged single zone heat pumps similar to CZs 2-15. The assumption deviates from 2022 Title24 ACM System Map that suggests a single zone dual fuel heat pump. Presumably this will not impact results significantly because the dual fuel system will be in heat-pump mode most times.
- The SHW design includes one 8.7 kW electric resistance hot water heater with a 5-gallon storage tank.

▪ **Quick-Service Restaurant**





- HVAC includes two SZAC (VAV or constant volume, depending on capacity) with gas furnace, one for kitchen and another for dining area. An exhaust fan is applied for kitchens in all climates based on prescriptive requirements in 2022 Title 24 code.
- The SHW design includes a gas storage water heater with a 100-gallon storage tank.





▪ **Small Hotel**

- The nonresidential HVAC design is a VAV reheat system with two gas hot water boilers, four packaged rooftop units (one serving each floor), and VAV terminal units with hot water reheat coils. The SHW design includes a small electric resistance water heater with 30-gallon storage tank.
- The guest room HVAC design includes one packaged SZAC unit with gas furnace serving each guest room. The water heating design includes a central gas water heater with a 250-gallon storage tank and recirculation pump, serving all guest rooms.

Table 2 summarizes the baseline mixed-fuel prototype characteristics, based on prescriptive 2022 Title 24 new construction requirements.

**Table 2. Baseline Prototype Characteristics**

|                                     | <br>Medium Office             | <br>Medium Retail             | <br>Quick-Service Restaurant | <br>Small Hotel  |
|-------------------------------------|--|--|--|---|
| <b>Conditioned floor area (ft²)</b> | 53,628   | 24,563   | 2,501  | 42,554<br>(77 guest rooms)<br>(Nonresidential area:<br>15,282 (36%))  |
| <b>Number of stories</b>            | 3  | 1  | 1  | 4   |
| <b>Window-to-Wall Area ratio</b>    | 0.33   | 0.07   | 0.11   | 0.14  |
| <b>Window U-factor/SHGC</b>         | U-factor:<br>CZ 1-8, 10, 16 – 0.36<br>CZ 9, 11-15 – 0.34<br>SHGC:<br>CZ 1-8, 10, 16 – 0.25<br>CZ 9, 11-15 – 0.22 | U-factor:<br>CZ 1-8, 10, 16 – 0.36<br>CZ 9, 11-15 – 0.34<br>SHGC:<br>CZ 1-8, 10, 16 – 0.25<br>CZ 9, 11-15 – 0.22 | U-factor:<br>CZ 1-8, 10, 16 – 0.36<br>CZ 9, 11-15 – 0.34<br>SHGC:<br>CZ 1-8, 10, 16 – 0.25<br>CZ 9, 11-15 – 0.22 | <u>Nonresidential:</u><br>U-factor:<br>CZ 1-8,10,16 – 0.36<br>CZ 9, 11-15 – 0.34<br>SHGC:<br>CZ 1-8,10,16 – 0.25<br>CZ 9, 11-15 – 0.22<br><br><u>Guest Rooms:</u><br>U-factor: 0.36<br>SHGC: 0.25 |
| <b>Solar PV size</b>                | 123 kW – 204 kW<br>Depending on CZ   | 64 kW – 87 kW<br>Depending on CZ   | None   | 17 kW – 25 kW<br>Depending on CZ  |
| <b>Battery Storage</b>              | 217 kWh – 360 kWh<br>Depending on CZ   | 70 kWh – 94 kWh<br>Depending on CZ   | None   | 16 kWh – 24 kWh<br>Depending on CZ  |

|                    | <br>Medium Office   | <br>Medium Retail   | <br>Quick-Service Restaurant | <br>Small Hotel  |
|--------------------|--|--|--|---|
| <b>HVAC System</b> | VAV reheat system with packaged rooftop units, gas boilers, VAV terminal units with hot water reheat | <u>CZ 1</u><br>Heat recovery for Core Retail space only<br><br>< 65 kBtu/h: SZHP<br>> 65 kBtu/h and < 240 kBtu/h: SZHP VAV<br>> 240 kBtu/h: SZHP VAV | < 65 kBtu/h:<br>SZAC + gas furnace<br><br>> 65 kBtu/h:<br>SZAC VAV   | <u>Nonresidential and Laundry:</u><br>VAV reheat system with packaged rooftop units, gas boilers, VAV terminal units with hot water reheat<br><br><u>Guest Rooms:</u> SZAC with gas furnaces                        |
| <b>SHW System</b>  | 5-gallon electric resistance water heater  | 5-gallon electric resistance water heater  | 100-gallon gas water heater  | <u>Nonresidential:</u> 30-gallon electric resistance water heater<br><u>Laundry Room:</u> 120-gal gas storage water heater<br><u>Guest rooms:</u> Central gas water heater, 250 gallons storage, recirculation loop |

## 3.2 Measure Definitions and Costs

The measures evaluated in the analysis fall into four different categories:



### Fuel Substitution

- Heat pump or electric space heating or gas furnace
- Heat pump or electric water heaters
- Electric cooking
- Electric clothes dryer
- Electrical panel capacity
- Natural gas infrastructure



### Energy Efficiency

- Envelope
- Mechanical equipment (HVAC and SHW)
- Lighting



### Load Flexibility

- Peak Load shedding
- Load shift



### Additional solar PV and/or battery storage.

These measures are detailed further in this section.

### 3.2.1 Fuel Substitution

The Reach Code Team investigated the cost and performance impacts and associated infrastructure costs associated with changing the mixed-fuel baseline HVAC and water heating systems to all-electric equipment for all prototypes except Medium Retail where the baseline is already an all-electric design.

For Medium Office, Quick Service Restaurant and Small Hotel, the fuel substitution measure entails electrification including heat pump space heating, electric resistance re-heat coils, electric water heaters with storage tank, heat pump water heating, increasing electrical capacity, and eliminating natural gas connections that would have been present in mixed-fuel new construction.





For Medium Retail with all-electric baseline, the fuel substitution measure entails mixed-fuel space conditioning system including single zone packaged AC with gas furnace, dual fuel heat pump, adding gas infrastructure costs and eliminating any additional electric infrastructure.

### **3.2.1.1 HVAC and Water Heating**

The 2022 T24 nonresidential standards analysis uses a mixed-fuel baseline for most of the Standard Design mechanical equipment, primarily gas for space heating, except for some heat pump scenarios in Retail prototype (see Table 2). Quick-Service Restaurant has a gas storage water heater in baseline, and heat pump water heater in all-electric scenario. The Small Hotel has a central gas water heating system serving the guest rooms and a separate gas storage water heater for laundry room. In the all-electric scenario, gas equipment serving HVAC and water heating end-uses is replaced with electric equipment. Full details of HVAC and water heating systems in baseline and proposed fuel substitution measure package are described in Table 3.

Regions of California covered by the South Coast Air Quality Management District have emissions restrictions imposed on mechanical equipment. The Reach Code Team investigated the potential cost implications of meeting these requirements for gas furnaces and boilers but found that costs are minimal for mechanical systems under 2,000,000 Btu/h, and therefore did not include them. All gas-fired mechanical systems in this study are under 2,000,000 Btu/h and are subject to only an initial permitting fee, while larger systems require additional permitting costs and annual renewals.

Table 3. HVAC and Water Heating Characteristics Summary

|      |                              | <br>Medium Office | <br>Medium Retail  | <br>Quick-Service<br>Restaurant | <br>Small Hotel   |
|------|------------------------------|--|---|--|--|
| HVAC | Baseline                     | Packaged DX + VAV with hot water reheat. Central <b>gas</b> boilers.                               | All zones and CZs: Single zone packaged <b>heat pumps</b>   | Packaged SZAC + <b>gas</b> furnace   | <u>Nonresidential</u> : Packaged DX + VAV with hot water reheat. Central <b>gas</b> boilers.<br><br><u>Guest Rooms</u> : Packaged SZAC + <b>gas</b> furnaces |
|      | Proposed – Fuel Substitution | Packaged DX + VAV with electric <b>resistance</b> reheat.  | <u>Core zone (&gt;30 ton)</u> : Packaged SZAC + VAV + <b>gas</b> furnace<br><u>Other small zones</u> : SZHP, or dual fuel heat pump for CZ 1 and 16 | Single zone packaged <b>heat pumps</b>   | <u>Nonresidential</u> : Packaged DX + VAV with electric <b>resistance</b> reheat<br><br><u>Guest Rooms</u> : SZHPs   |
| SHW  | Baseline                     | Electric <b>resistance</b> with storage  | Electric <b>resistance</b> with storage   | <b>Gas</b> storage water heater  | <u>Nonresidential</u> : Electric <b>resistance</b> storage<br><br><u>Guest Rooms</u> : Central <b>gas</b> storage with recirculation                         |
|      | Proposed – Fuel Substitution |  |   | Unitary <b>heat pump</b> water heater  | <u>Nonresidential</u> : Electric <b>resistance</b> storage<br><br><u>Guest Rooms</u> : Central <b>heat pump water heater</b> with recirculation              |

The Reach Code Team received cost data for mechanical equipment from two experienced mechanical design firms including equipment and material, labor, subcontractors (for example, HVAC and SHW control systems), and contractor overhead.

### 3.2.1.1.1 Medium Office

For the Medium Office all-electric HVAC design, the Reach Code Team investigated several potential all-electric design options, including variable refrigerant flow, packaged heat pumps, and variable volume and temperature systems. The most likely all-electric replacement for a central gas boiler serving a variable air volume reheat system would be a central heat pump boiler; however, this system cannot be modeled in CBECC at the time of writing of this report. As such, Reach Code Team is treating this analysis as temporary until a compliance pathway is established for a central heat pump boiler in the Energy Code and results can be updated accordingly. This modeling capability is anticipated by Q1 2023 according to discussions with the CBECC software development team, and the cost-effectiveness analysis should become available in the first half of 2023.



After seeking feedback from the design community and considering the software modeling constraints, the Reach Code Team determined that the most feasible all-electric HVAC system is a VAV system with an electric resistance reheat instead of hot water reheat coil. A parallel fan-powered box (PFPB) implementation of electric resistance reheat

would further improve efficiency due to reducing ventilation requirements, but an accurate implementation of PFPBs is not currently available in compliance software.

The actual gas consumption for the VAV hot water reheat baseline may be higher than the current simulation results due to a combination of boiler and hot water distribution losses. A recent research study shows that the total losses can account for as high as 80 percent of the boiler energy use.<sup>4</sup> If these losses are considered savings for the electric resistance reheat (which has zero associated distribution loss), cost-effectiveness may be higher than presented.

The all-electric SHW system remains the same electric resistance water heater as the baseline and has no associated incremental costs. Cost data for Medium Office designs are presented in Table 4. The all-electric HVAC system presents cost savings compared to the hot water reheat system from elimination of the hot water boiler and associated hot water piping distribution. CZ10 and CZ15 all-electric design costs are slightly higher because they require larger size rooftop heat pumps than the other CZs.

**Table 4. Medium Office Average Mechanical System Costs**

| Components (HVAC Only)                 |  Baseline – Mixed Fuel |  Proposed – All-electric | Incremental Cost                   |
|--|---|---|------------------------------------|
| <b>Description</b>                     | Packaged units, boilers, hot water piping, VAV boxes, ductwork, grilles                                 | Packaged units, electric resistance VAV boxes, electric circuitry, ductwork, grilles                        | VAV Boxes, electric infrastructure |
| <b>Material</b>                        | \$491,630   | \$438,555   | \$(53,075)                         |
| <b>Labor</b>                           | \$173,816   | \$102,120   | \$(71,696)                         |
| <b>Electric Infrastructure</b>         | \$0   | \$112,340   | \$112,340                          |
| <b>Gas Infrastructure</b>              | \$17,895  | \$0   | \$(17,895)                         |
| <b>Overhead &amp; CZ adjustment **</b> | \$267,052   | \$250,114   | \$(16,938)                         |
| <b>TOTAL</b>                           | <b>\$950,393</b>  | <b>\$903,129</b>  | <b>\$(47,264)</b>                  |

\*\* The overhead and CZ adjustment factors are presented in Section 8.3.

### 3.2.1.1.2 Medium Retail



The baseline HVAC system includes five packaged single zone heat pumps. Based on fan control requirements in [Section 140.4\(m\)](#), units with cooling capacity  $\geq 65,000$  Btu/h have variable air volume fans, while smaller units have constant volume fans. For the Medium Retail proposed fuel substitution scenario, the Reach Code Team assumed one large Single Zone Packaged ACs with gas furnaces to replace the two smaller packaged heat pumps in the large core thermal zone. The all-electric SHW system remains the same electric resistance water heater as the baseline and has no associated incremental costs. In addition, according to the prescriptive requirement in Section 140.4 (q), the air system of Core Retail Zone in CZ1 meets the requirement in Table 140.4 J, which should include exhaust air heat recovery. Cost data for Medium Retail designs are presented in Table 5. Costs for rooftop air-conditioning systems are very similar to rooftop heat pump systems.

<sup>4</sup> Raftery, P., A. Geronazzo, H. Cheng, and G. Paliaga. 2018. Quantifying energy losses in hot water reheat systems. *Energy and Buildings*, 179: 183-199. November. <https://doi.org/10.1016/j.enbuild.2018.09.020>. Retrieved from <https://escholarship.org/uc/item/3qs8f8qx>

For climate zones 2 to 15, the proposed fuel substitution HVAC design includes three SZHP units (VAV or constant volume, depending on capacity) based on prescriptive requirements and one large SZAC that is between 35-45 tons for the core zone.

For climate zones 1 and 16, the smaller capacity (<240 kBtu/h) thermal zones may have either of dual-fuel SZHPs or SZACs, depending on capacity. The core zone with 35-to-45-ton cooling capacity is assumed to have one large SZAC. CZ 1 also assumes an exhaust air heat recovery system for core zone based on prescriptive requirement in Title 24 Part 6 Section 140.4.

**Table 5. Medium Retail Average Mechanical System Costs**

| Components (HVAC Only)      |  Baseline – All-electric |  Proposed – Mixed Fuel | Incremental Cost                                     |
|-----------------------------|---|--|--|
| Description                 | SZHPs   | Single zone AC + furnace, SZHP, or dual fuel SZHP, depending upon capacity and CZ                        | SZAC with gas furnace, Added gas infrastructure cost |
| HVAC – Material             | \$189,160   | \$183,157  | \$(6,003)  |
| HVAC – Labor                | \$54,785  | \$52,886   | \$(1,899)  |
| Electric Infrastructure     | \$0   | \$0  | -  |
| Gas Infrastructure          | \$0   | \$17,895   | \$17,895   |
| Overhead & CZ adjustment ** | \$94,600  | \$98,519   | \$3,919  |
| <b>TOTAL</b>                | <b>\$338,546</b>  | <b>\$352,458</b>   | <b>\$13,912</b>                                      |



\*\* The overhead and CZ adjustment factors are presented in Section 8.3.

### 3.2.1.1.3 Quick-Service Restaurant

The baseline HVAC system includes two packaged single zone rooftop ACs with gas furnaces. Based on fan control requirements in [Section 140.4\(m\)](#), units with cooling capacity  $\geq 65,000$  Btu/h have variable air volume fans, while smaller units have constant volume fans. The SHW design includes one central gas storage water heater with 150 kBtu/h input capacity and a 100-gallon storage tank. For the QSR all-electric design, the Reach Code Team assumed packaged heat pumps and an A.O. Smith CHP-120 heat pump water heater with a 120-gallon storage tank. Cost data for the QSR designs are presented in Table 6, which shows the costs for full electrification of the HVAC and water heating equipment.

The Team has not included costs of electrifying the cooking equipment because of the negative impact on cost-effectiveness, as demonstrated in a [2021 Restaurants cost-effectiveness study](#) (TRC, P2S Engineers, and Western Allied Mechanical 2022). The HVAC and SHW electrification packages are referred to as the HS package to reflect all-electric HVAC and SHW.

**Table 6. Quick-Service Restaurant Average Mechanical System Costs - HS Package**

| Components              |  Baseline – Mixed Fuel |  Proposed – All-electric | Incremental Cost          |
|-------------------------|---|--|---------------------------|
| Description             | Single zone AC + furnace, gas storage water heater  | SZHP, heat pump water heater   | HVAC +SHW electrification |
| HVAC Material           | \$50,065  | \$52,785   | \$2,719                   |
| HVAC Labor              | \$6,748   | \$6,249  | \$(499)                   |
| SHW – Material          | \$10,198  | \$13,720   | \$3,523                   |
| SHW – Labor             | \$2,650   | \$2,529  | \$(121)                   |
| Electric Infrastructure | \$0   | \$12,960   | \$12,960                  |

|                             |           |           |          |
|-----------------------------|-----------|-----------|----------|
| Gas Infrastructure          | \$17,895  | \$15,878  | -\$2,017 |
| Overhead & CZ adjustment ** | \$41,633  | \$47,612  | \$5,979  |
| TOTAL                       | \$150,838 | \$173,382 | \$22,544 |

\*\* The overhead and CZ adjustment factors are presented in Section 8.3.



3.2.1.1.4 Small Hotel

The Small Hotel has two different baseline equipment systems, one for the nonresidential spaces and one for the guest rooms. The nonresidential HVAC system includes two gas hot water boilers, four packaged rooftop units, and twenty-eight VAV terminal boxes with hot water reheat coil. The SHW design includes a small electric water heater with storage tank for nonresidential areas and gas storage water heater dedicated to laundry room. The guest rooms HVAC design includes one single-zone AC unit with gas furnace for each guest room, and the water heating design includes one central gas storage water heater with a recirculation pump for all guest rooms.

For the Small Hotel all-electric design, the Reach Code Team assumed the nonresidential HVAC system to be packaged heat pumps with electric resistance VAV terminal units, and the SHW system will remain a small electric resistance water heater. As described in Section 3.2.1.1.1 above, a central heat pump boiler may be the most commonly employed system type but was not evaluated in this study because of modeling limitations. For the guest room all-electric HVAC system, the Team assumed SZHPs and a central heat pump water heater serving all guest rooms. For the laundry room, all-electric HVAC system is same as other nonresidential areas and all-electric water heating is a split heat pump water heater. The central heat pump water heater includes a temperature maintenance loop with an electric resistance backup heater.

Cost data for Small Hotel designs are presented in Table 7. The all-electric design presents substantial cost savings because there is no hot water plant or piping distribution system serving the nonresidential spaces. The incremental cost savings are further enhanced considerably if packaged terminal heat pumps (PTHPs) are used instead of SZHPs in guest rooms compared to split DX/furnace systems with individual flues.

**Table 7. Small Hotel HVAC and Water Heating System Costs**



| Components                             | <br>Baseline – Mixed Fuel   | <br>Proposed – All-electric   | Incremental Cost  |
|--|--|---|---|
| <b>Description</b>                     | Non-residential spaces: Packaged units, boilers, hot water piping, VAV boxes, ductwork, grilles, gas water heater for laundry<br><br>Guest rooms: SZAC + furnace, central gas water heater | Non-residential spaces: Packaged units, electric resistance VAV boxes, electric circuitry, ductwork, grilles, heat pump water heater for laundry<br><br>Guest rooms: SZHP, central heat pump water heater | HVAC (NR and Guest Rooms) Electrification<br>SHW (Laundry Room and Guest Rooms) |
| <b>HVAC - Material</b>                 | \$802,004  | \$625,642   | \$(176,361)   |
| <b>HVAC - Labor</b>                    | \$366,733  | \$282,394   | \$(84,339)  |
| <b>SHW - Material</b>                  | \$55,829   | \$139,087   | \$83,258  |
| <b>SHW - Labor</b>                     | \$11,780   | \$15,080  | \$3,300   |
| <b>Electric Infrastructure</b>         | \$-  | \$119,625   | \$119,625   |
| <b>Gas Infrastructure</b>              | \$74,943   | \$-   | \$(74,943)  |
| <b>Overhead &amp; CZ adjustment **</b> | \$518,741  | \$461,001   | \$(57,739)  |
| <b>TOTAL</b>                           | <b>\$1,830,029</b>   | <b>\$1,642,830</b>  | <b>\$(187,199)</b>  |
| <b>TOTAL HVAC (PTHP option)</b>        | <b>\$1,830,029</b>   | <b>\$1,161,178</b>  | <b>\$(668,851)</b>  |

\*\* The overhead and CZ adjustment factors are presented in 8.3.

### 3.2.1.2 Commercial Cooking Equipment

For Quick-Service Restaurant prototype, the Reach Code Team evaluated electrification of commercial cooking equipment extensively in 2019 Restaurants Cost Effectiveness analysis and leveraged it for cost and other specifications for the this study. It assumes a Type I exhaust hood and shows high incremental cost affecting the cost-effectiveness of this measure. Table 8 summarizes the quick-service restaurant cooking equipment costs for both mixed-fuel and all-electric scenarios.

**Table 8. Quick-Service Restaurant Cooking Equipment Costs**

| Components                    | <br>Baseline – Mixed Fuel | <br>Proposed – All-electric (non “HS” scenario) | Incremental Cost                  |
|-------------------------------|--|---|-----------------------------------|
| <b>Description</b>            | Gas based appliances   | Electric cooking appliance  | Cooking appliance electrification |
| <b>Cooking equipment cost</b> | \$21,649   | \$43,534  | \$21,886                          |
| <b>TOTAL</b>                  | <b>\$21,649</b>  | <b>\$43,534</b>   | <b>\$21,886</b>                   |



This measure also adds electric infrastructure cost as detailed in Table 10 below.

### 3.2.1.3 Commercial Clothes Dryer

For the all-electric measure, the Reach Code Team assumed electric resistance clothes dryers for Small Hotel prototype. Commercial-scale heat pump clothes dryers take significantly longer time to dry compared to a conventional

gas or electric dryer and are not common in the United States On-Premise Laundry (OPL) market, where labor is relatively expensive and use of heat pump dryers implies hotels may need to require more than one shift to perform laundry duties. Most commercial clothes dryers are available in models that use either gas or electricity as the fuel source, so there is negligible incremental cost for electric resistance dryers. Table 9 summarizes the Small Hotel construction costs for both mixed-fuel and all-electric OPL scenarios.

Table 9. Small Hotel Clothes Dryer Costs

| Components         |  Baseline – Mixed Fuel |  Proposed – All-electric | Incremental Cost |
|--------------------|---|--|------------------|
| Description        | Gas clothes dryer   | Electric resistance clothes dryer  | -                |
| Clothes Dryer cost | \$29,342  | \$29,342   | \$0              |
| TOTAL              | \$29,342  | \$29,342   | \$(0)            |

This measure also adds electric infrastructure cost as detailed in Table 10 below.

3.2.1.4 Infrastructure Impacts

3.2.1.4.1 Electrical infrastructure

Electric heating appliances and equipment often require a larger electrical connection than an equivalent gas appliance because of the higher voltage and amperage necessary to electrically generate heat. Thus, many buildings may require larger electrical capacity than a comparable building with natural gas appliances. This includes:

- Electric resistance VAV space heating in the medium office and common area spaces of the small hotel.
- Heat pump water heating for the guest room spaces of the small hotel.

Table 10 details the cost impact of additional electrical panel sizing and wiring required for all-electric scenarios as compared to their corresponding mixed-fuel scenario. The costs are based on estimates from one contractor. The Reach Code Team excluded costs associated with electrical service connection upgrades because these costs are very often rate-based and highly complex.

Table 10. Electrical Infrastructure Costs

|                                 | Mixed-Fuel Equipment   | All-electric Equipment   | Electrical Infrastructure Impact  | Incremental Cost |
|---------------------------------|--|--|---|------------------|
| <b>Medium Office</b>            | Hot water reheat system with gas boiler plant and VAV boxes with hot water reheat coils  | VAV boxes with electric resistance reheat coils  | Upgraded transformers, transformer feeders, switchboards, and branch circuits | \$ 112,340       |
| <b>Medium Retail</b>            | Mix of SZHPs and single zone AC plus furnace serving all zones   | SZHPs serving all zones  | Electrical requirements are driven by cooling capacity, so no impact.         | \$0              |
| <b>Quick-Service Restaurant</b> | Gas water heater   | Heat pump water heater   | Upgraded switchboard, transformer feeder, and branch circuits                 | \$12,960         |
|                                 | Gas Water heater, Gas cooking  | Heat pump water heater, Electric cooking   | Upgraded switchboard, transformer feeder, and branch circuits                 | \$95,260         |
| <b>Small Hotel</b>              | <u>Guest rooms HVAC:</u> Single zone AC plus furnace<br><br><u>Non-residential spaces HVAC:</u> Hot water reheat system with gas boiler plant and VAV boxes with hot water reheat coils.<br><br><u>Water heating:</u> Gas water heating serving both laundry and guest rooms.<br><br><u>Process:</u> Gas dryers. | <u>Guest rooms HVAC:</u> SZHPs<br><br><u>Non-residential spaces HVAC:</u> VAV boxes with electric resistance reheat coils.<br><br><u>Water heating:</u> Heat pump water heating serving both laundry and guest rooms.<br><br><u>Process:</u> Electric resistance dryers. | Upgraded transformers, transformer feeders, switchboards, and branch circuits | \$119,625        |

#### 3.2.1.4.2 Gas Piping

The Reach Code Team assumes that gas would not be supplied to the site in an all-electric new construction scenario. Eliminating natural gas in new construction would save costs associated with connecting a service line from the street main to the building, piping distribution within the building, and monthly connection charges by the utility.

The Reach Code Team determined that for a new construction building with natural gas piping, there is a service line (branch connection) from the natural gas main to the building meter. Table 11 gives a summary of the gas infrastructure costs by component, assuming 1-inch corrugated stainless-steel tubing (CSST) material is used for the plumbing distribution. The Reach Code Team assumes that the gas meter costs vary depending on the gas load. Based on typical space heating loads for all building types, the Reach Code Team categorized CZs 1 and 16 as 'High-load CZs' and CZs 2-15 as 'Low-load CZs'. The Reach Code Team assumed an interior plumbing distribution length based on the expected layout. Table 12 gives the total gas infrastructure cost by building type. The costs are based on estimates from one contractor.

**Table 11. Gas Infrastructure Costs by Component**

| Component  | Details                             | Cost     |
|--|-------------------------------------|----------|
| <b>Meter, including Pressure Regulator, and Earthquake Valve</b> | Low load CZ (CZ 2-15)               | \$11,056 |
|  | High load CZ (CZ 1,16)              | \$15,756 |
| <b>Gas lateral</b>   | Cost per linear foot of 1" CSST     | \$40     |
| <b>Connection charges</b>  | Includes street cut and plan review | \$1,015  |
| <b>Interior plumbing distribution</b>                            | Cost per linear foot of 1" CSST     | \$40     |

**Table 12. Total Gas Infrastructure Cost Estimates by Building Type**

| Building Prototype              | Interior plumbing distribution length (ft) | Total gas infrastructure cost |              |
|---------------------------------|--|-------------------------------|--------------|
|                                 |  | Low load CZ                   | High load CZ |
| <b>Medium Office</b>            | 100  | \$17,307                      | \$22,007     |
| <b>Medium Retail</b>            | 100  | \$17,307                      | \$22,007     |
| <b>Quick-Service Restaurant</b> | 100  | \$2,017*                      |              |
| <b>Small Hotel</b>              | 1,412                                      | \$70,243                      | \$74,943     |

\*The Quick-Service Restaurant package includes gas cooking appliances, which will require a gas lateral and meter. These costs represent only the interior plumbing distribution costs that would have served the HVAC and SHW systems.

### 3.2.2 Efficiency

The Reach Code Team started with a potential list of energy efficiency measures proposed for the 2025 Title 24 energy code update by the Statewide Building Codes Advocacy program (CASE Team)<sup>5</sup>, which initially included over 500 options. Other options originated in previous energy code cycles or were drawn from other codes or standards (examples: ASHRAE 90.1 and International Energy Conservation Code [IECC]), literature reviews, or expert recommendations. The Reach Code Team leveraged the CASE Team's assessment tools for the 2025 Cycle, focusing on measures prioritized by the CASE Team. The Reach Code Team filtered the list of potential measures based on building type (to remove measures that applied to building types not covered in this study), measure category (to remove end-uses and loads that are not relevant to the prototypes) and impacts to new construction. Based on this filtering, the Team was left with around 100 measures to consider. The Reach Code Team ranked this list of potential measures based on applicability to the prototypes in this study, ability to model in simulation software, demonstrated energy savings potential, and market readiness.

Please note that the **measures requiring a ruleset update cannot currently be modeled for compliance purposes**. The modeling method for each efficiency measure is defined in their respective measure descriptions in Section 3.2.2.1 and if the ruleset amendment was applied. Please refer to Section 2.5 for further details.

The subsections below describe the energy efficiency measures that the Team analyzed, including description, modeling approach, and specification.

#### 3.2.2.1 Envelope

1. **Cool Roof:** Requires higher reflectance and emittance values for the Medium Office building only. This measure was not shown to produce substantial savings in the other prototypes.

<sup>5</sup> <https://title24stakeholders.com/>

Modeling: Modeled cool roof measure in efficiency measures package by updating Aged Solar Reflectance (ASR) and/or Thermal Emittance (TE) in CBECC software.

Specification: Increased ASR from 0.63 to 0.70 with a TE of 0.85 in CZs 4 and 6-15.

2. **Efficient Vertical Fenestration:** Requires lower U-factor and Solar Heat Gain Coefficient (SHGC) for windows in select climate zones for three building types (Medium Office, Retail, and Small Hotel). The measure details and the climate zone selection are based on the proposition of 2022 NR CASE Report (Statewide CASE Team 2020 B).

Modeling: Modeled high performance windows in efficiency measures package by updating U-factor and SHGC inputs in CBECC software.

Specification: Reduced U-factor from 0.36 to 0.34 and SHGC from 0.25 to 0.22 in CZs 2, 6, 7 and 8 for Medium Office and Retail, Reduced U-factor from 0.36 to 0.34 and SHGC from 0.25 to 0.22 in all CZs for Small Hotel.

3. **Vertical Fenestration as a Function of Orientation:** Limit the amount of fenestration area as a function of orientation for the Medium Office. East-facing and west-facing windows are each limited to one-half of the average amount of north-facing and south-facing windows.

Modeling: Change z-coordinate input of windows in CBECC software for Medium Office to increase or decrease fenestration area for the Medium Office.

Specification: Decreased east-facing and west-facing fenestration area from 468 to 390 square feet. Increased north-facing and south-facing fenestration area from 703 to 781 square feet.

### 3.2.2.2 Mechanical Equipment (SHW and HVAC)

4. **Water Efficient Fixtures in Kitchen:** Specifies commercial dishwashers that use 20% less water than ENERGY STAR® specifications. In addition, the dishwasher includes heat recovery function such that it only needs connection to cold water and reduces hot water demand and central SHW system capacity. For QSRs, which typically specify a three-compartment sink for dishwashing, this measure would replace or add a dishwasher to reduce total hot water load. The measure also adds 1.0 gallon per minute (GPM) faucet aerators to hand-washing sinks in the kitchen to reduce water usage. Title 20 requires kitchen sinks to have a flow rate of 1.8 GPM at most. The reduced hot water load from the water efficient fixtures above allows the heat pump water heater (HPWH) to operate without an electric resistance back-up.

Modeling: Reduced water usage in the ruleset based on calculations of expected water usage from literature review and fixture specifications. HPWH coefficient of performance (COP) is increased since there is no electric resistance back-up.

Specification: Decreased hot water usage by 26% in the software ruleset (13.4 gallons per person to 9.9 gallons per person) and increased HPWH COP from 3.1 to 4.2.

5. **Ozone Washing Machines:** Adds an ozone system to the large on-premises washing machines. The ozone laundry system generates ozone, which helps clean fabrics by chemically reacting with soils in cold water. This measure saves energy by reducing hot water usage and by reducing cycle time for laundry systems. Refer to DEER Deemed measure SWAP005-01 for more information (California Public Utilities Commission 2022).

Modeling: Reduced the total runtime of each cycle and hot water hourly usage per person (gallons per hour per person) for laundry area in software ruleset.

Specification: Reduced hot water usage by 85%, from 48.4 to 7.3 gal/hour-person based on the deemed measure data from the California electronic Technical Reference Manual (California Technical Forum 2022).

- 6. Efficient Hot Water Distribution:** Reduces domestic hot water (DHW) distribution system pipe heat losses in two ways. First, the Team used pipe sizing requirements in Appendix M of the California Plumbing Code instead of Appendix A. Appendix M reduces pipe diameters for the cold and hot water supply lines based on advancements made in water efficiency standards for plumbing fixtures found in hotel bathrooms. Second, the Team added more stringent pipe insulation thickness requirements for hotels to match that of single and multifamily dwellings using Title 24 Table 160.4-A *Pipe Insulation Thickness Requirements for Multifamily DHW Systems* instead of Table 120.3-A.

Modeling: The Team calculated the pipe heat loss savings for the Small Hotel prototype by following the modelling methodology applied to the low-rise loaded corridor multi-family building prototype in the 2022 CASE Multifamily Domestic Hot Water Distribution report (Statewide CASE Team 2020 A). The Team designed a riser distribution system for the Small Hotel prototype building using the baseline Appendix A and modern Appendix M pipe sizing tables. The pipe design and total pipe surface area of the supply and return lines for the Small Hotel closely matched the Low-Rise Loader Corridor Building prototype. The hotel insulated pipe heat loss for both Appendix A and M was approximated from the multifamily building heat loss modelling results for the 16 CZs and water heater energy savings calculated for the two sub-measures.

Specification: (a) Pipe diameter decreased from Appendix A requirements to Appendix M multifamily plumbing requirements (b) For pipe diameters at or above 1.5 inches, increase the insulation thickness from 1.5 to two inches thick for fluids operating in the 105-140°F temperature range. . The Team reduced the DHW energy consumption by 0.4 – 0.7% depending on CZ in a post-processing of the model.

- 7. Demand Control Ventilation (DCV) and Transfer Air:** The California Energy Code requires kitchen exhaust to have DCV if the exhaust rate is greater than 5,000 cfm. This measure expands this requirement and applies DCV regardless of the exhaust rate for the QSR. Additionally, the kitchen makeup air supply is decreased by requiring at least 15% of replacement air to come from the transfer air in the dining space that would otherwise be exhausted.

Modeling: Changed exhaust fan from constant speed fan to variable speed and reduce kitchen ventilation airflow rate for the QSR.

Specification: Changed Kitchen Exhaust Fan Control Method to Variable Flow Variable Speed Drive, reduced kitchen ventilation from 2,730 cfm to 2,293 cfm.

- 8. Guest Room Ventilation and Fan Power:** Uses the 2021 IECC fan power limitation requirements for ventilation fans under 1/12 horsepower, and approximates the ASHRAE 90.1 Small Hotel guestroom control requirements, which require shutting off ventilation within five minutes of all occupants leaving the room and changing the cooling setpoint to at least 80°F and heating setpoint to at most 60°F.

Modeling: Since variable occupancy cannot be modeled in CBECC, the Reach Code Team revised the software ruleset ventilation schedule and setpoints from 8:00 AM to 7:00 PM—the time range where the CBECC software assumed occupancy to be less than half for all guestrooms.

Specification: Heating setpoint reduced from 68°F to 66°F, cooling setpoint increased from 78°F to 80°F PM, and ventilation shut off from 8:00 AM to 7:00 PM. Guestroom ventilation fans have fan efficacy of 0.263 W/cfm.

- 9. Variable speed Fans:** Require variable speed fans at lower capacities than required by Title 24 Part 6 Section 140.4(m), currently at 65,000 Btu/hr. This measure is based on the 2022 Title 24 Part 6, Section 140.4(m),

where direct expansion units greater than 65,000 Btu/hr that control the capacity of the mechanical cooling directly shall have a minimum of two stages of mechanical cooling capacity and variable speed fan control.

- Modeling: Reduced the cooling capacity threshold from 65,000 Btu/hr to 48,000 Btu/hr. Changed the supply fan control from constant speed to variable speed for zones that have cooling capacity > 48,000 Btu/hr and < 65,000 Btu/hr in the Medium Retail and QSR.
- Specification: Changed the supply fan control from Constant Volume to Variable Speed Drive for the Front Retail and Point-of-Sale thermal zones in Medium Retail prototype and the Dining Zone in the QSR prototype.

### 3.2.2.3 Lighting

- 10. Interior lighting reduced lighting power density:** Update lighting power densities (LPD, measured as Watts/ft<sup>2</sup>) requirements based on technology advances (e.g., optical efficiency, thermal management, and improved bandgap materials). Identify spaces with opportunities for more savings from lowered LPDs—not all spaces are subject to LPD reductions. Take into consideration IES recommended practices and biological effectiveness metrics (such as WELL) when developing the proposed LPD values (WELL 2022).

The 2022 Indoor Lighting CASE Study (Statewide CASE Team 2021 D) provided a survey of 2x2 troffer products available in the Design Lights Consortium Qualified Products List (DLC-QPL) and the efficacy level each measured. This study indicated that at the time of the report approximately 20% of available DLC-QPL products exceeded the performance level of the ‘Standard’ DLC-QPL listing by approximately 15%, meeting the ‘Premium’ listing criteria. The Title 24 2022 CASE Report uses the ‘Standard’ designation performance level as the design baseline for all the LPD calculations in the code. This document proposes using the ‘Premium’ designation performance as the basis of the LPD allowances.

A DOE study on solid-state light sources (LEDs) provides projections of efficacy improvement for LED light sources that are in the range of 2.5 to 3% per year, continuing for the next five or ten years (U.S. Department of Energy 2019 B). So, the products offered for sale by the luminaire manufacturers are improving as older products are discontinued and newer ones are introduced. Even in just three years, the overall performance of the products available can improve by 7 to 9%.

A recent Navigant LED pricing study shows a slightly negative cost to efficacy correlation, indicating that higher performing products may be slightly lower in cost (Navigant Consulting 2018). This is likely to be in part caused by the decreasing cost of the LED chips with each subsequent generation produced. There is likely to be no cost associated with employing higher performing LED luminaires.

- Modeling: Reduce LPDs by approximately 13% in each space listed below under regulated lighting below Title 24 prescriptive requirements.

- Specification:
- Medium Office
    - All spaces: 0.52 W/ft<sup>2</sup>
  - Medium Retail
    - Storage: 0.36 W/ft<sup>2</sup>
    - Retail sales: 0.86 W/ft<sup>2</sup>
    - Main entry lobby: 0.63 W/ft<sup>2</sup>
  - QSR
    - Dining: 0.41 W/ft<sup>2</sup>
    - Kitchen: 0.86 W/ft<sup>2</sup>
  - Small Hotel

Stairs: 0.54 W/ft<sup>2</sup>  
Corridor: 0.36 W/ft<sup>2</sup>  
Lounge: 0.50 W/ft<sup>2</sup>

The measures are summarized below by building type, including measure costs, in Table 13.

**Table 13. Efficiency Measures Applicability, Costs, and Sources**

| Measure Applicability  |  |  |            |            |                          |                          |                             |   |   |
|--|--|--|------------|------------|--------------------------|--------------------------|-----------------------------|---|---|
| <ul style="list-style-type: none"> <li>Included in packages with energy efficiency measures</li> <li>Not Applicable</li> </ul> |  |  |            |            |                          |                          |                             |   |   |
| Measure  | Baseline T24 Requirement   | Proposed Measure                               | Med Office | Med Retail | Quick-Service Restaurant | Small Hotel: Guest Rooms | Small Hotel: Nonresidential | Incremental Cost  | Sources & Notes   |
| <b>Envelope</b>  |  |  |            |            |                          |                          |                             |   |   |
| 1. Cool Roof   | For low slope roofs:<br>ASR = 0.63<br>TE = 0.75                          | For low slope roofs:<br>ASR = 0.7<br>TE = 0.85 | •          | –          | –                        | –                        | –                           | \$0.04/ft <sup>2</sup>  | Final Nonresidential High Performance Envelope Case Report (Statewide CASE Team 2020 B)       |
| 2. Efficient Vertical Fenestration   | U-factor = 0.36<br>SHGC = 0.25   | U-factor = 0.34<br>SHGC = 0.22                 | •          | •          | –                        | •                        | •                           | \$1.75/ft <sup>2</sup>  | Final Nonresidential High Performance Envelope Case Report (Statewide CASE Team 2020 B)       |
| 3. Vertical Fenestration as a Function of Orientation  | 40% window-to-wall ratio in each orientation per Title 24 Table 140.3-B. | Redistribute window areas by orientation       | •          | –          | –                        | –                        | –                           | \$0   | No additional cost. This measure is a design consideration.                                   |
| <b>HVAC and SHW</b>  |  |  |            |            |                          |                          |                             |   |   |
| 4. Water Efficient Fixtures in Kitchen   | Kitchen faucet max flow rate is 1.8 GPM (Title 20)                       | Kitchen faucet flow rate is 1 GPM              | –          | –          | •                        | –                        | –                           | High efficiency, door-type, high temperature dishwasher: \$7,633/unit<br>Faucet aerator: \$8/unit | Combination of literature review, online sources such as Home Depot and manufacturer websites |
| 5. Ozone Washing Machine   | Not required   | Reduced hot water use                          | –          | –          | –                        | –                        | •                           | \$25,469/unit   | DEER Deemed measure SWAP005-01 (California Public Utilities Commission 2022)                  |

**Measure Applicability**

- Included in packages with energy efficiency measures
- Not Applicable

| Measure   | Baseline T24 Requirement  | Proposed Measure   | Med Office | Med Retail | Quick-Service Restaurant | Small Hotel: Guest Rooms | Small Hotel: Nonresidential | Incremental Cost | Sources & Notes   |
|---|---|--|------------|------------|--------------------------|--------------------------|-----------------------------|------------------|---|
| 6. Efficient Hot Water Distribution                           | Appendix A Pipe Sizing with standard pipe insulation thickness 1.5"                                     | Appendix M pipe sizing with 2" pipe insulation thickness | —          | —          | —                        | •                        | —                           | \$5,819          | Multifamily Domestic Hot Water Final CASE Report  |
| 7. DCV & Transfer Air   | DCV required in kitchen for exhaust air rate > 5000 cfm   | DCV for all exhaust fans                                 | —          | —          | •                        | —                        | —                           | \$8,500          | Mechanical contractor cost estimate   |
| 8. Guest Room Ventilation, Temperature Setback, and Fan Power | Guest rooms required to have occupancy sensing zone controls, but no ventilation fan power requirement. | Updated fan power and HVAC schedules                     | —          | —          | —                        | •                        | —                           | \$0              | No cost increase, as guest rooms already have controls.   |
| 9. Variable Speed Fans  | Variable speed required if cooling capacity is greater than 65,000 Btu/h                                | Variable speed control for smaller capacity systems      | —          | •          | •                        | —                        | —                           | \$6,390/unit     | Mechanical contractor cost estimate   |
| <b>Lighting</b>   |   |  |            |            |                          |                          |                             |                  |   |
| 10. Interior Lighting Reduced LPD                             | Per Area Category Method, varies by Primary Function Area.  | Top 20% of market products                               | •          | •          | •                        | —                        | •                           | \$0              | Industry report on LED pricing analysis shows that costs are not correlated with efficacy. (Navigant Consulting 2018) |

### 3.2.3 Load Flexibility

The Reach Code Team investigated a range of high-impact demand flexibility strategies potentially applicable to the four prototypes. The list of strategies is informed by DOE's Grid-interactive Efficient Buildings efforts and the 2022 Nonresidential Grid Integration CASE report (U.S. Department of Energy 2021, Statewide CASE Team 2020). The Team selected the three measures based on their load flexibility potential, cost, compliance software modeling capabilities, savings potential and the ease of project implementation and field verification:

Please note that these measures require a ruleset update and cannot be modeled currently for compliance purposes.

- 11. Temperature Setback using Smart Thermostat:** This measure leverages the existing mandatory requirement for HVAC zone thermostatic controls to pre-condition spaces prior to, and to shed demand during, peak period. This measure introduces a setback in temperature setpoint during peak period and incurs no additional cost because Occupant-Controlled Smart Thermostats (OCSTs) are already required for buildings similar to the Medium Office prototype.

Modeling: Instead of utilizing the demand responsive features, OCST would be used to change temperature setpoints and setpoint schedules. These changes were integrated by altering the setpoint schedules directly in the backend ruleset files of CBECC software.

Specification: In the base case, the Medium Office prototype HVAC equipment schedules dictate "on" hours (at desired temperature) from 6:00 AM through 12:00 AM on weekdays and 6:00 AM – 7:00 PM on Saturdays. All Sunday hours are "off." Cooling setpoints are 75°F during "on" and 85°F when "off" hours; heat setpoints are 70°F during "on" and 60°F during "off" hours. The Team modified this schedule such that the "on" setpoints are stepped back by 2°F from 4:00 PM through 12:00 AM on weekdays; and from 4:00 PM – 7:00 PM on Saturdays.

- 12. Demand Response Capable HPWH:** The Reach Code Team modeled a measure intended to reduce the peak demand of the significant hot water loads in the QSR prototype. The measure increases costs due to adding a 100-gallon storage tank and plumbing hardware. The additional hot water storage enables pre-heating water ahead of demand by effectively increasing the HPWH's thermal storage capacity. The extra plumbing hardware is needed to keep the stored hot water stratified to maintain efficient HPWH operations. The Team did not directly address the issue of storage tank location but assumed floor plan design would be able to accommodate it.

Modeling: The measure uses the HPWH and additional storage tank capacity to produce and store hot water ahead of actual use during evening peak period. QSR hot water baseline schedule exhibits a low morning load (6:00 AM – 8:00 AM), moderate load near lunch time (11:00 AM), and a peak evening load (4:00 PM – 11:00 PM). These changes were made by changing the hot water load fraction in the ruleset.

Specification: Implements an early pre-heat that starts at 12:00 PM and finishes by 7:00 PM, avoiding the super peak hours of 7:00 PM – 9:00 PM.

- 13. Demand Response Lighting:** This measure extends existing Title 24 mandatory requirements for demand responsive lighting by shedding demand during peak hours. There are no additional measure costs because demand responsive control capability is already required for nonresidential buildings with more than 4kW of total lighting load. This measure does not require additional commissioning.

Modeling: The baseline lighting schedule exhibits a plateau of 0.65 load fraction from 8:00 AM – 8:00 PM and trails off after 8:00 PM through the end of the day for weekdays. The Team altered the ruleset to reduce the load fraction during 4:00 PM – 9:00 PM.

Specification: The Team implemented a 10% setback during the 4-9pm peak hours.

The load flexibility measure applications to each prototype are summarized in Table 14.

**Table 14. Load Flexibility Measure Summary**

| Measure                             | Med Office | Med Retail | QSR | Small Hotel | Incremental Cost | Other Notes   |
|-------------------------------------|------------|------------|-----|-------------|------------------|---|
| <b>11. Smart Thermostat</b>         | •          | -          | -   | -           | \$0              | Capability already required   |
| <b>12. Demand Control HPWH</b>      | -          | -          | •   | -           | \$5,400          | An additional 100-gallon tank, plumbing hardware, and related labor hours |
| <b>13. Demand Response Lighting</b> | •          | -          | -   | -           | \$0              | Capability already required   |

None of the measures apply to the Medium Retail or Small Hotel prototypes. While the Small Hotel contains some office space and common areas, the Medium Office load flexibility measures were not applied to the Small Hotel spaces because of the potential for unpopular impacts, varying occupancy schedules, difficult field maintenance, and limited energy impacts. Team also explored the impact of load flexibility in all-electric clothes dryer scenario but did not see enough savings impact, hence the measure was not included in the package.

### 3.2.4 Additional Solar PV and Battery Storage

The Reach Code Team considered additional solar PV and battery storage measures that exceed the 2022 Title 24 prescriptive requirements to improve the cost-effectiveness of proposed scenarios. For Medium Office and Retail, the prescriptive solar PV sizes are large enough to occupy the entirety of the available roof space. Additional rooftop solar PV could not be considered for the two prototypes. For the Quick-Service Restaurant, solar PV is not prescriptively required since the prototype qualifies for the exception and the Reach Code Team considered adding solar PV to improve cost-effectiveness. For Small Hotel, the required PV size in the code-compliant models did not occupy the entire available roof space. Additional PV system capacity was considered as a measure to improve cost-effectiveness.

For the cost-effectiveness analysis, the Team evaluated additional solar PV for all-electric scenarios for the two building types, Quick Service Restaurant and Small Hotel. The additional PV size is calculated based on available roof space, assuming the maximum available space is 50% of total roof space and 15 Watt per square foot panel size.

Modeling: Updated PV capacity (kW) input in CBECC software.  
Specification: Baseline requirement is 0 kW and 22-32.6 (depending on climate zone) kW for Quick-Service Restaurant and Small Hotel respectively. Proposed measure specification is 18.8 kW and 79.8 kW for Quick-Service Restaurant and Small Hotel respectively.

The costs for PV include first cost to purchase and install the system, inverter replacement costs, and annual maintenance costs. A summary of incremental costs and sources is given in Table 15 below.

Table 15. Additional Solar PV Measure Summary

| Measure  | Med Office | Med Retail | QSR | Small Hotel | Incremental Cost  | Cost Source  |
|----------|------------|------------|-----|-------------|---|--|
| Solar PV | -          | -          | •   | •           | First Cost: \$3.20/W<br>Inverter replacement cost at 10-yr: \$0.15/W<br>Annual Maintenance Cost: \$0.02/W<br>ITC Federal Incentive: 30% | National Renewable Energy Laboratory (NREL) Q1 2016 (National Renewable Energy Laboratory 2016)<br><br>E3 Rooftop Solar PV System Report (Energy and Environmental Economics, Inc. 2017) |

Upfront solar PV system costs are lowered because of the federal income tax credit (ITC)—approximately 30 percent based on the passage of Inflation Reduction Act. PV energy output is built into CBECC and is based on NREL’s PVWatts calculator, which includes long term performance degradation estimates.

A battery storage system is prescriptively required for three prototypes: Medium Office, Medium Retail, and Small Hotel. The current software, CBECC v1.0, applies the appropriate prescriptive battery size (kWh) and capacity (kW) in the standard design. However, the control assumed in standard design is “Basic Control”, which does not function for optimum battery use. The Team did not evaluate additional battery measures because the compliance software does not apply the “Time of Use” battery control method in standard design, which impacts the incremental energy costs and TDV benefits.

### 3.3 Measure Packages

The Reach Code Team compared a baseline Title 24 prescriptive package to mixed-fuel packages and two to four electrification packages depending on applicability of building type. Note that *most* QSR all-electric packages exclude kitchen electrification, while the Small Hotel all-electric package does include electric laundry cost and energy impacts.

- **Mixed Fuel Code Minimum:** Mixed-fuel prescriptive building per 2022 Title 24 requirements.
- **Mixed Fuel + Efficiency Measures:** Mixed-fuel prescriptive building per 2022 Title 24 requirements, including additional efficiency measures.
- **All-electric Code Minimum Efficiency:** All-electric building to minimum Title 24 prescriptive standards and *federal* minimum efficiency standards. This package has the same PV size as mixed-fuel prescriptive baseline.
- **All-electric Energy Efficiency:** All-electric building with added energy efficiency measures related to HVAC, SHW, lighting or envelope.
- **All-electric Energy Efficiency + Load Flexibility:** All-electric building with added energy efficiency and load flexibility measures.
- **All-electric Energy Efficiency + Solar PV:** All-electric building with added energy efficiency and additional Solar PV. The added PV size is larger than prescriptive 2022 Title 24 code requirements and accounts for roof space availability.

For QSR, the Reach Code Team has analyzed two scenarios for all-electric packages, one with electric cooking and the one with gas cooking (the latter of which is referred to as the “HS” package to reflect all-electric HVAC and SHW). The results section includes results for both scenarios since all-electric package with electric cooking appliance can be cost-effective in POU territories. This study did not evaluate pre-empted package with all-electric HVAC and SHW to

have higher efficiency than required by federal regulations, that will potentially enhance cost-effectiveness and/or compliance margins.

For Small Hotel, the Reach Code Team also analyzed an alternative scenario with PTHP instead of SZHP in all-electric scenario. It is denoted by the “PTHP” in parenthesis in package name.

## 4 Cost-Effectiveness Results

Cost-effectiveness results are presented in this section and the attached workbook per prototype and measure packages described in Section 3. The TDV and On-Bill based cost-effectiveness results are presented in terms of B/C ratio and NPV.

In the following figures, the result **Both** (shown in green shading) indicates that the result is cost-effective on both On-Bill and (Total) TDV basis. The result **On-Bill** or **TDV** (shown in yellow shading) indicates that the result is either cost-effective on On-Bill or (Total) TDV basis, respectively. The result “ - ” (results with no shading) indicates that the result is not cost-effective on either an On-Bill basis or (Total) TDV basis.

Across all prototypes and climate zones, efficiency measures improve cost-effectiveness when added to the mixed-fuel baseline prototype and all-electric federal code minimum designs.

All-electric cost-effectiveness results by prototype can be summarized as:



**Medium Office** (Figure 1): All-electric space heating is predominantly achieved through electric resistance due to modeling limitations, which limits operational benefits. Efficiency measures yield some On-Bill cost-effective all-electric packages in milder climate zones. Adding load flexibility measures increases the cost-effectiveness to most climates.



**Medium Retail** (Figure 2): All-electric packages are cost-effective in all climate zones with added efficiency measures over all-electric baseline. Proposed mixed-fuel packages are cost-effective too with added efficiency measures in most climate zones primarily driven by cost-equivalency in the all-electric package compared to a mixed-fuel package.



**Quick-Service Restaurant** (Figure 3): All-electric package with and without cooking electrification is cost-effective in CPAU and SMUD territories only, On-Bill. All-electric HVAC and SHW package with added efficiency measures is On-Bill cost-effective in CZs 1, 3-5 and 12. Adding efficiency and solar PV is On-Bill cost-effective in CZs 1-5, 11-13, and 16. While not depicted in Figure 3, the Results Workbook indicates that all-electric HVAC and SHW plus efficiency packages are *nearly* cost-effective (greater than -\$350/month) in all climate zones using On-Bill Net Present Values.




**Small Hotel** (Error! Reference source not found.): The all-electric hotel has tremendous cost savings compared to a mixed-fuel package, primarily due to the avoidance of gas infrastructure to each guest room. All-electric packages achieve TDV cost-effectiveness in all CZs except 16. On-Bill cost-effectiveness is limited to CZs 2-5, 12 and 15 with single zone ducted heat pumps, but nearly all CZs with a packaged terminal heat pump.

## 4.1 Medium Office

In the all-electric Medium Office building, the upfront cost savings associated with avoiding boiler and gas infrastructure supports cost-effective packages in several climate zones, particularly with additional efficiency and load flexibility measures.

- Adding energy efficiency measures over mixed fuel code minimum is On-Bill cost-effective in all climate zones.
- The all-electric code minimum efficiency package is cost-effective for CZs 4 (CPAU), 6-10, 12 (SMUD) and 15.
- Adding energy efficiency measures to the all-electric code minimum package extends On-Bill cost-effectiveness to CZ 3 as well.
- All-electric energy efficiency along with load flexibility measure package is On-Bill cost-effective in most climate zones except 1, 11 and 16.

**Figure 1. Medium Office Cost-Effectiveness Summary**


| Climate Zone  |   | CZ1  | CZ2  | CZ3     | CZ4     | CZ5  | CZ6  | CZ7   | CZ8  | CZ9     | CZ10    | CZ11    | CZ12 | CZ13 | CZ14    | CZ15 | CZ16 |
|---|---|------|------|---------|---------|------|------|-------|------|---------|---------|---------|------|------|---------|------|------|
| Prototype   | Utility   | PG&E | PG&E | PG&E    | PG&E    | PG&E | SCE  | SDG&E | PG&E | SCE     | SDG&E   | PG&E    | PG&E | PG&E | SDG&E   | SCE  | PG&E |
|   | Package   |      |      |         | CPAU    | SCG  |      |       |      |         | SCE     |         | SMUD |      | SCE     |      |      |
|  <b>Medium Office (MO)</b> | Mixed Fuel + Efficiency Measures                  | Both | Both | Both    | Both    | Both | Both | Both  | Both | Both    | Both    | Both    | Both | Both | Both    | Both | Both |
|   | All Electric Code Minimum Efficiency              | –    | –    | –       | On-Bill | –    | Both | Both  | Both | On-Bill | On-Bill | –       | –    | –    | –       | Both | –    |
|   | All Electric Energy Efficiency                    | –    | –    | On-Bill | Both    | –    | Both | Both  | Both | Both    | Both    | –       | –    | –    | –       | Both | –    |
|   | All-Electric Energy Efficiency + Load Flexibility | –    | Both | Both    | Both    | Both | Both | Both  | Both | Both    | Both    | On-Bill | Both | Both | On-Bill | Both | –    |

## 4.2 Medium Retail

2022 Title 24 code prescriptively requires heat pumps in most scenarios already. This report evaluates added energy efficiency measures over the baseline all-electric scenario and proposed mixed-fuel packages.

- The mixed-fuel code minimum is not cost-effective by itself in most climate zones.
- Adding energy efficiency measures to the mixed-fuel code minimum package is On-Bill and/or TDV cost-effective in most climate zones.
- Adding energy efficiency measures over prescriptive all-electric package is also cost-effective in most climate zones except CZ16 using TDV.

**Figure 2. Medium Retail Cost-effectiveness Summary**


| Climate Zone   |                                  | CZ1  | CZ2  | CZ3  | CZ4          | CZ5  | CZ6  | CZ7   | CZ8  | CZ9  | CZ10         | CZ11    | CZ12         | CZ13 | CZ14               | CZ15 | CZ16    |
|--|----------------------------------|------|------|------|--------------|------|------|-------|------|------|--------------|---------|--------------|------|--------------------|------|---------|
| Prototype  | Utility                          | PG&E | PG&E | PG&E | PG&E         | PG&E | SCE  | SDG&E | PG&E | SCE  | SDG&E        | PG&E    | PG&E         | PG&E | SDG&E              | SCE  | PG&E    |
|  | Package                          | PG&E | PG&E | PG&E | CPAU         | SCG  | SCE  | SDG&E | PG&E | SCE  | SCE          | PG&E    | SMUD         | PG&E | SCE                | SCE  | PG&E    |
| Retail (RE)<br> | Mixed Fuel Code Minimum          | Both | –    | –    | –            | –    | –    | –     | –    | –    | –            | –       | –            | –    | On-Bill<br>On-Bill | –    | On-Bill |
|  | Mixed Fuel + Efficiency Measures | Both | Both | Both | Both<br>TDV  | Both | Both | Both  | Both | TDV  | On-Bill<br>– | On-Bill | Both<br>TDV  | Both | Both               | Both | On-Bill |
|  | All Electric Energy Efficiency   | Both | Both | Both | Both<br>Both | Both | Both | Both  | Both | Both | Both<br>Both | Both    | Both<br>Both | Both | Both               | Both | On-Bill |

### 4.3 Quick-Service Restaurant (QSR)

High incremental cost for HVAC and SHW electrification (“HS” package) makes restaurant electrification challenging. Because cooking electrification packages are very expensive – both upfront and operationally in IOU territories – the Team evaluated HS packages that do not consider cooking equipment electrification. This affects cost-effectiveness as gas infrastructure cost savings do not materialize.

- Adding energy efficiency measures over mixed fuel code minimum is On-Bill cost-effective in all climate zones.
- All-electric HVAC and SHW “HS” package is On-Bill cost-effective in CZ4 (CPAU) and CZ12 (SMUD) territory only.
- Adding energy efficiency and load flexibility measures extends On-Bill cost-effectiveness to CZs 1, 3 and 5.
- All-electric HVAC and SHW “HS” package with energy efficiency and solar PV measure is On-Bill cost-effective in climate zones 1-5, 11-13 and 16.
- All-electric package including cooking electrification is On-Bill cost-effective in CZ 4 (CPAU) territory only.
- The Results Workbook indicates that all-electric HVAC and SHW plus efficiency packages are nearly cost-effective (greater than -\$350/month) in all climate zones using On-Bill Net Present Values.

Figure 3. QSR Cost-effectiveness Summary


| Climate Zone  |  | CZ1     | CZ2     | CZ3     | CZ4     | CZ5     | CZ6  | CZ7   | CZ8  | CZ9  | CZ10  | CZ11    | CZ12    | CZ13    | CZ14  | CZ15 | CZ16    |
|---|--|---------|---------|---------|---------|---------|------|-------|------|------|-------|---------|---------|---------|-------|------|---------|
| Utility   |  | PG&E    | PG&E    | PG&E    | PG&E    | PG&E    | SCE  | SDG&E | PG&E | SCE  | SDG&E | PG&E    | PG&E    | PG&E    | SDG&E | SCE  | PG&E    |
| Prototype   | Package  | PG&E    | PG&E    | PG&E    | CPAU    | SCG     | SCE  | SDG&E | PG&E | SCE  | SCE   | PG&E    | SMUD    | PG&E    | SCE   | SCE  | PG&E    |
| <br>Quick-Service Restaurant (QSR) | Mixed Fuel + Efficiency Measures                     | Both    | Both    | Both    | Both    | Both    | Both | Both  | Both | Both | Both  | Both    | Both    | Both    | Both  | Both | Both    |
|   | All Electric HS Code Minimum Efficiency              | –       | –       | –       | On-Bill | –       | –    | –     | –    | –    | –     | –       | On-Bill | –       | –     | –    | –       |
|   | All Electric HS Energy Efficiency                    | On-Bill | –       | On-Bill | On-Bill | On-Bill | –    | –     | –    | –    | –     | –       | On-Bill | –       | –     | –    | –       |
|   | All-Electric HS Energy Efficiency + Load Flexibility | On-Bill | –       | On-Bill | On-Bill | –       | –    | –     | –    | –    | –     | –       | On-Bill | –       | –     | –    | –       |
|   | All Electric HS Energy Efficiency + Solar PV         | On-Bill | On-Bill | On-Bill | On-Bill | On-Bill | –    | –     | –    | –    | –     | On-Bill | On-Bill | On-Bill | –     | –    | On-Bill |
|   | All Electric Code Minimum Efficiency                 | –       | –       | –       | On-Bill | –       | –    | –     | –    | –    | –     | –       | –       | –       | –     | –    | –       |
|   | All Electric Energy Efficiency                       | –       | –       | –       | On-Bill | –       | –    | –     | –    | –    | –     | –       | –       | –       | –     | –    | –       |

## 4.4 Small Hotel

The all-electric hotel has cost savings compared to a mixed-fuel package, primarily due to the avoidance of boilers and gas infrastructure to each guest room. The analysis assumes single zone ducted heat pump for all all-electric scenarios; however, the Team analyzed a Packaged Terminal Heat Pump (PTHP) scenario as well. PTHP shows higher incremental cost savings as compared to a baseline of mixed fuel single zone packaged system and hence are cost-effective in many climate zones.

- Adding energy efficiency measures over mixed fuel code minimum is On-Bill cost-effective in all climate zones.
- All-electric code minimum packages with or without energy efficiency measure packages are TDV cost-effective in all climate zones except 16, and On-Bill cost-effective in CZ4 (CPAU) and CZ12 (SMUD) due to relatively lower electricity costs.
- Additional solar PV over all-electric energy efficiency package extends On-Bill cost-effectiveness to CZs 2, 3, 4 (PG&E), 5 and 15.
- The alternative all-electric scenario with PTHP is cost-effective in all climates, On-Bill in most CZs except 7,10 and 14 SDG&E territories.

Figure 4. Small Hotel Cost-effectiveness Summary

| Climate Zone   |   | CZ1  | CZ2  | CZ3  | CZ4  | CZ5  | CZ6  | CZ7   | CZ8  | CZ9  | CZ10  | CZ11 | CZ12 | CZ13 | CZ14  | CZ15 | CZ16 |
|--|---|------|------|------|------|------|------|-------|------|------|-------|------|------|------|-------|------|------|
| Prototype  | Utility                                     | PG&E | PG&E | PG&E | PG&E | PG&E | SCE  | SDG&E | PG&E | SCE  | SDG&E | PG&E | PG&E | PG&E | SDG&E | SCE  | PG&E |
|  | Package                                     |      |      |      | CPAU | SCG  |      |       |      |      | SCE   |      | SMUD |      | SCE   |      |      |
|  Small Hotel (SH) | Mixed Fuel + Efficiency Measures            | Both | Both | Both | Both | Both | Both | Both  | Both | Both | Both  | Both | Both | Both | Both  | Both | Both |
|  | All Electric Code Minimum Efficiency        | TDV  | TDV  | TDV  | TDV  | TDV  | TDV  | TDV   | TDV  | TDV  | TDV   | TDV  | TDV  | TDV  | TDV   | TDV  | –    |
|  | All Electric Energy Efficiency              | TDV  | TDV  | TDV  | TDV  | TDV  | TDV  | TDV   | TDV  | TDV  | TDV   | TDV  | TDV  | TDV  | TDV   | TDV  | –    |
|  | All Electric Energy Efficiency + Solar PV   | TDV  | Both | Both | Both | Both | TDV  | TDV   | TDV  | TDV  | TDV   | TDV  | Both | TDV  | TDV   | Both | –    |
|  | All Electric Code Minimum Efficiency (PTHP) | Both | Both | Both | Both | Both | Both | TDV   | Both | Both | Both  | Both | Both | Both | Both  | Both | Both |

## 5 Energy Code Compliance Results and Reach Code Considerations

This section combines the cost-effectiveness and 2022 Title 24 energy code compliance metric results — efficiency TDV, total TDV, and source energy, described in Section 2.3 — to highlight the viable reach code options for local jurisdictions. The Reach Code Team calculated metrics using both:

1. Software outputs using the ACM standard design and
2. Manually by subtraction against the baseline model because of software limitations that are beyond the Reach Code Team's control.<sup>6</sup>

All Efficiency TDV margins presented in this section are the lower of the two approaches, Software output and Manual, to be conservative and inform the minimum compliance margins that can be met by a typical modeler. Full details of compliance margins and cost-effectiveness results are presented in the Final Results Workbook for reference.

Importantly, the workbook shows that for all prototypes, all-electric packages are capable of achieving greater greenhouse savings as compared to mixed-fuel buildings. Below is a summary of how compliance results as well as cost-effectiveness for each prototype and package could influence reach code options. The Reach Code Team outlines recommendations using the following framework, based on reach codes that were adopted across California under the 2019 building code cycle:

- **Mixed fuel buildings are allowed, with efficiency.** Local amendments governing efficiency and conservation must be performed in the Title 24 Part 6 Building Energy Efficiency Standards and be approved by the Energy Commission.
  - *Energy Efficiency* — Require energy efficiency for buildings regardless of fuel type. A jurisdiction can require different compliance thresholds for all-electric and/or mixed-fuel. The thresholds should be set considering how they may affect mixed-fuel or all-electric buildings.
  - *Electric-Preferred* — Allow mixed-fuel appliances but require a higher building performance via efficiency, total, or source compliance metric (for example, (Milpitas 2019), section 140.1).<sup>7</sup> Applies only to mixed-fuel buildings.
- **Mixed fuel buildings are not allowed.** Local amendments governing green building requirements may be performed in the Title 24 Part 11 Green Building Standards Code and must be filed with the Building Standards Commission. Alternatively, the local amendment may be performed in a municipal code chapter of their respective jurisdictions.
  - *All-Electric* — Require certain all-electric only appliances, with exceptions (for example (Menlo Park 2019)). Does not involve efficiency or conservation measures, and cost-effectiveness is not a legal requirement.<sup>8</sup> Local amendments may be performed through other building code sections, such as Part 11. See discussion on Exceptions below.
  - *All-Electric + Efficiency* — Require certain all-electric appliances, but with a higher building performance via efficiency, total, or source compliance metric. Also requires amendment to Title 24 Part 6 and approval by the Energy Commission.

<sup>6</sup> The difference between the two methods of calculating TDV margins occurs due to various software limitations. The Team had challenges modeling a baseline showing zero-percent (exactly compliant) compliance margin, and differing interpretations of 2022 Title 24 code regarding fan power, exhaust fan, heat recovery, battery control, and other aspects. Most scenarios show similar trends between software calculated compliance margin and the Team's manual subtraction against baseline model, with a difference in magnitude. For example, if the Total TDV Compliance margin as shown by software directly is negative, it is typically negative per manual calculation as well. Nonetheless, modeling limitations introduce error into the calculations, which may affect results. Many scenarios have very low negative compliance margin and are very close to being zero. While this uncertainty in error may lead to imprecision in results, relative performance across packages can yield information helpful for decision-making.

<sup>7</sup> Note Milpitas has since adopted an All-electric with Exceptions code for the 2022 code cycle.

<sup>8</sup> See letter from [CEC to South San Francisco](#) for reference.

Exceptions enable reach codes to broadly require electrification except for specific building systems. These systems may have uncertainty on energy code compliance, building industry electrification approaches, or other related impacts on economic development. During the 2019 code cycle, cities developed exemptions based on discussions with local stakeholders, resulting in a wide array of exemption types.<sup>9</sup> For the four prototypes in this study, the Team has determined two exemptions that may be necessary for cities passing All-Electric reach codes.

- **Building systems without a prescriptive compliance pathway in the energy code.** This exemption considers that all-electric central space heating does not have a prescriptive pathway in Title 24, and central heat pump boilers cannot be currently modeled, which has impacted compliance results for the Medium Office and Small Hotel. This exemption has broad precedence and can apply to other large nonresidential buildings (e.g., (Berkeley 2019), section 12.80.040.A Exception 1). These exemptions typically state that the building is also not able to comply via the performance approach using commercially available technology.
- **Commercial cooking.** Cooking electrification does not considerably impact code compliance but is not nearly cost-effective against a mixed-fuel baseline. To account for this challenge, cities may wish to adopt reach codes that exempt commercial kitchen cooking appliances (e.g., (Menlo Park 2019) 100.0(e)2.A Exception 4).

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<sup>9</sup> See list of exemptions on [Bay Area Reach Codes](#).

**Table 16. Reach Code Pathway Considerations**

| Prototype                       | Compliance and Cost-Effectiveness Results Summary  | Energy Efficiency  | Electric-Preferred | All-Electric   | All-Electric + Efficiency  |
|---------------------------------|--|--|--------------------|--|--|
| <b>Medium Office</b>            | <p>The Team could not identify any all-electric package that complies with all three compliance metrics, with the Efficiency TDV Compliance margin being the most challenging.</p> <p>Future iterations of this study will re-evaluate the Medium Office with a central heat pump boiler, an anticipated compliance software capability in early 2023, instead of electric resistance VAVs.</p>  | To Be Determined. Modeling constraints impacted achievable compliance margins for all-electric packages. | All CZs.           | Exempt building systems without a prescriptive pathway in the energy code.   | To Be Determined. Modeling constraints impacted achievable compliance margins for all-electric packages  |
| <b>Medium Retail</b>            | <p>The Team identified cost-effective and code compliant packages of all-electric + energy efficiency measures across most CZs.</p> <p>Mixed-fuel + efficiency was cost-effective but not code compliant in most CZs.</p>  | CZs 7 and 9.   | CZs 7 and 9.       | CZs 2-15. 2022 T24 prescriptive baseline   | CZs 1-10, 12-14.   |
| <b>Quick-Service Restaurant</b> | <p>The Mixed-fuel + efficiency package is cost-effective and compliant in many climate zones. Code compliance and cost-effectiveness results support reach code adoption for all-electric space conditioning and service water heating when adding efficiency and solar PV for CZs 1 and 3-5, many others are likely to be compliant with future modeling input updates. Cost-effectiveness is achieved or <i>nearly</i> achieved (Net Present Value is greater than -\$350/month) On-Bill in all CZs.</p> <p>Cooking electrification does not impact code compliance but is not cost-effective against a mixed-fuel baseline except for CPAU territory.</p> | CZs 1, 3-7.  | CZs 1-7, 13.       | CZs 1, 3-7. Exempt commercial kitchen appliances, except CZ4 (CPAU). Nearly all remaining CZs have a <i>nearly</i> cost-effective and/or nearly compliant pathway for HVAC and SHW only. | CZs 1, 3-5.  |
| <b>Small Hotel</b>              | <p>Results support Electric-Preferred reach code for all CZs. The all-electric packages are <i>near</i> compliant and TDV cost-effective for most CZs when including energy efficiency measures and additional solar PV. They are <i>likely</i> to be compliant with future modeling iterations.</p> <p>Future iterations of this study will re-evaluate the nonresidential areas of the hotel with a central heat pump boiler, as mentioned for the Medium Office, which can potentially improve code compliance.</p>   | To Be Determined. Modeling constraints impacted achievable compliance margins for all-electric packages. | All CZs.           | Exempt building systems without a prescriptive pathway in the energy code.   | To Be Determined. Modeling constraints impacted achievable compliance margins for all-electric packages. |

The combined result of cost-effectiveness and code compliance across all climate zones and packages are detailed in Section 0 through 5.4 below. The tables are formatted to show:

- Cost-effectiveness results with color highlight:
  - **Green** highlight — for scenarios that are cost-effective on both On-Bill and TDV metrics, may or may not be compliant.
  - **Yellow** highlight — for scenarios that are cost-effective on either one of the On-Bill/TDV metrics, may or may not be compliant.
  - **Gray** highlight — for scenarios that are not cost-effective on either metric, either compliant currently or likely to be compliant in future.
  - White highlight — for scenarios that are not cost-effective on either metric and are not compliant.
- Compliance results with cell values:
  - “EffTDV Margin” percentages — for scenarios that are compliant, across both Manual and CBECC software output, the reported value is the minimum of the two.
  - “-” for scenarios that do not comply across any one code compliance metric.

“TBD” – for scenarios that are likely to be compliant with modeling updates or software versions in future, maybe compliant across either one of the Manual or CBECC software output approach or has a system type modeling limitation such as central heat pump boiler for Medium Office and Small Hotel. The package names in table results columns are as follows, as defined in Section 3.3:

- **Mixed fuel — Code Min:** Mixed Fuel Code Minimum Efficiency
- **Mixed fuel — EE:** Mixed Fuel + Efficiency Measures
- **All-electric — Code Min:** All-electric Code Minimum Efficiency
- **All-electric — EE:** All-electric Energy Efficiency
- **All-electric — EE + LF:** All-electric Energy Efficiency and Load Flexibility
- **All-electric — EE + PV:** All-electric Energy Efficiency and Solar PV

The QSR has two electrification scenarios, with and without cooking appliance electrification, which is denoted by “HS” prefix.

The Small Hotel has an extra package that evaluates a different HVAC type in the all-electric Code Minimum Efficiency package, a Packaged Terminal Heat Pump (PTHP) instead of a Single Zone Heat Pump.

## 5.1 Medium Office

For Medium Office, the Reach Code Team analyzed EE measures over mixed fuel baseline model and three electrification packages: 1) Code Min, 2) EE and 3) EE + LF packages, results shown in Table 17.

The most likely all-electric replacement for a central gas boiler serving a VAV reheat system would be a central heat pump boiler; however, this system cannot be modeled in CBECC at the time of the writing of this report. As such, the Reach Code Team is treating this analysis as temporary until a compliance pathway is established for a central heat pump boiler in the Energy Code and results can be updated accordingly. This modeling capability is anticipated in early 2023 according to discussions with the CBECC software development team, and the cost-effectiveness analysis should become available in the first half of 2023. Heat pump systems are multiple times more efficient, but may also be multiple times more costly, than the electric resistance reheat systems currently analyzed.

- Results support reach code adoption for energy efficiency measures over mixed fuel baseline, also known as the “Electric-Preferred”. A compliance margin of 4–5% is achievable depending on the climate zone.
- No all-electric package complies with all three-compliance metrics, with the efficiency compliance TDV margin being the most challenging. The Reach Code Team explored other efficiency measures that reduce the efficiency compliance TDV margin, but not enough to make the TDV margin positive. The compliance values are labeled as “TBD” for all-electric packages, as they are likely to be compliant with future modeling and/or software updates. Some climate zones are compliant currently on either one of the Software output or Manual compliance approaches.

**Table 17. Cost-effectiveness and Compliance Summary – Medium Office**

| CZ     | Utility | Mixed Fuel | All-electric |     |         |
|--------|---------|------------|--------------|-----|---------|
|        |         | EE         | Code Min     | EE  | EE + LF |
| cz01   | PG&E    | 4%         | TBD          | TBD | TBD     |
| cz02   | PG&E    | 5%         | TBD          | TBD | TBD     |
| cz03   | PG&E    | 5%         | TBD          | TBD | TBD     |
| cz04   | PG&E    | 4%         | TBD          | TBD | TBD     |
| cz04-2 | CPAU    | 4%         | TBD          | TBD | TBD     |
| cz05   | PG&E    | 5%         | TBD          | TBD | TBD     |
| cz05-2 | SCG     | 5%         | TBD          | TBD | TBD     |
| cz06   | SCE     | 6%         | TBD          | TBD | TBD     |
| cz07   | SDG&E   | 7%         | TBD          | TBD | TBD     |
| cz08   | SCE     | 6%         | TBD          | TBD | TBD     |
| cz09   | SCE     | 4%         | TBD          | TBD | TBD     |
| cz10   | SDG&E   | 4%         | TBD          | TBD | TBD     |
| cz10-2 | SCE     | 4%         | TBD          | TBD | TBD     |
| cz11   | PG&E    | 3%         | TBD          | TBD | TBD     |
| cz12   | PG&E    | 4%         | TBD          | TBD | TBD     |
| cz12-2 | SMUD    | 4%         | TBD          | TBD | TBD     |
| cz13   | PG&E    | 4%         | TBD          | TBD | TBD     |
| cz14   | SDG&E   | 4%         | TBD          | TBD | TBD     |
| cz14-2 | SCE     | 4%         | TBD          | TBD | TBD     |
| cz15   | SCE     | 3%         | TBD          | TBD | TBD     |
| cz16   | PG&E    | 4%         | TBD          | TBD | TBD     |

\* These results will be re-evaluated with central heat pump boiler system instead of electric resistance VAV systems, which largely are unable to achieve energy code compliance.

| Cell Color |  | Cell Value |   |
|------------|--|------------|---|
|            | Cost effective on both TDV/On-Bill metrics   | X%         | EffTDV Compliance Margin percentages (Lowest common)<br>Compliant on both Manual and Software output approaches                     |
|            | Cost effective on either TDV/On-Bill metrics | TBD        | Likely to comply with future modeling updates or software versions,<br>maybe compliant on either Manual or Software output approach |
|            | Compliant, not cost effective                | -          | Not compliant on either approach  |
|            | Not compliant nor cost effective             |            |   |

## 5.2 Medium Retail

For Medium Retail, the Team analyzed EE measure package over an all-electric baseline model and two mixed fuel packages — Code Min and EE, with results in Table 18.

- Results support reach code adoption for energy efficiency measures over mixed fuel code minimum package, also known as “Electric-Preferred” or “Energy Efficiency” reach code pathways in climate zones 7 and 9.
- Results also support “All-Electric + Efficiency” reach code option, with compliance margins of 4-14% above the all-electric code minimum baseline in climate zones 1-10 and 12-14.
- For some scenarios in climate zone 6, 8, 11, 15 and 16, labeled as “TBD”, the package is cost-effective and likely to be compliant in future with modeling input and/or software version updates.

**Table 18. Cost-effectiveness and Compliance Summary – Medium Retail**

| CZ     | Utility | Mixed Fuel |     | All-electric |
|--------|---------|------------|-----|--------------|
|        |         | Code Min   | EE  | EE           |
| cz01   | PG&E    | -          | -   | 6%           |
| cz02   | PG&E    | -          | -   | 4%           |
| cz03   | PG&E    | -          | -   | 12%          |
| cz04   | PG&E    | -          | -   | 11%          |
| cz04-2 | CPAU    | -          | -   | 11%          |
| cz05   | PG&E    | -          | -   | 12%          |
| cz05-2 | SCG     | -          | -   | 12%          |
| cz06   | SCE     | -          | TBD | 9%           |
| cz07   | SDG&E   | -          | 12% | 14%          |
| cz08   | SCE     | -          | TBD | 8%           |
| cz09   | SCE     | -          | 11% | 12%          |
| cz10   | SDG&E   | -          | -   | 3%           |
| cz10-2 | SCE     | -          | -   | 3%           |
| cz11   | PG&E    | -          | -   | TBD          |
| cz12   | PG&E    | -          | -   | 10%          |
| cz12-2 | SMUD    | -          | -   | 10%          |
| cz13   | PG&E    | -          | -   | 4%           |
| cz14   | SDG&E   | -          | -   | 7%           |
| cz14-2 | SCE     | -          | -   | 7%           |
| cz15   | SCE     | -          | -   | TBD          |
| cz16   | PG&E    | -          | -   | TBD          |

| Cell Color |  | Cell Value |   |
|------------|--|------------|---|
|            | Cost effective on both TDV/On-Bill metrics   | X%         | EffTDV Compliance Margin percentages (Lowest common)<br>Compliant on both Manual and Software output approaches                     |
|            | Cost effective on either TDV/On-Bill metrics | TBD        | Likely to comply with future modeling updates or software versions,<br>maybe compliant on either Manual or Software output approach |
|            | Compliant, not cost effective                | -          | Not compliant on either approach  |
|            | Not compliant nor cost effective             |            |   |

### 5.3 Quick-Service Restaurant (QSR)

The Team analyzed efficiency measures over a mixed fuel baseline and electrification packages, with and without cooking appliance electrification. For the “HS” scenario including HVAC and SHW electrification only, packages with EE, EE + LF and EE + PV were analyzed, with results in Table 19.

- Results support reach code adoption for energy efficiency measures over a mixed fuel baseline, also known as “Electric-Preferred” in climate zones 1 to 7 and 13, or “Energy Efficiency” in CZs 1 and 3 to 7.
- All-electric “HS” HVAC and SHW electrification can be adopted in CZs 1 and 3-7 since it is code compliant and *nearly* cost effective on at least one metric when energy efficiency measures and/or load flexibility or solar PV measure is added, demonstrated by yellow or gray cells.
- All-electric “HS” HVAC and SHW option with additional efficiency measures can be adopted in CZs 1 and 3-5. Adding solar PV makes the package on-bill cost-effective on at least one metric marked as yellow cells..
- Packages labeled as “TBD” may or may not be cost-effective but are likely to be compliant in the future with modeling input and/or software updates.

**Table 19. Cost-effectiveness and Compliance Summary – Quick-Service Restaurant (without cooking electrification)**

| CZ     | Utility | Mixed Fuel | All-electric "HS" (HVAC+SHW) |     |         |         |
|--------|---------|------------|------------------------------|-----|---------|---------|
|        |         | EE         | Code Min                     | EE  | EE + LF | EE + PV |
| cz01   | PG&E    | 16%        | -                            | 6%  | 16%     | 6%      |
| cz02   | PG&E    | 6%         | -                            | TBD | TBD     | TBD     |
| cz03   | PG&E    | 18%        | -                            | 8%  | 13%     | 8%      |
| cz04   | PG&E    | 16%        | -                            | 5%  | 8%      | 5%      |
| cz04-2 | CPAU    | 16%        | -                            | 5%  | 8%      | 5%      |
| cz05   | PG&E    | 18%        | -                            | 8%  | 15%     | 8%      |
| cz05-2 | SCG     | 18%        | -                            | 8%  | 15%     | 8%      |
| cz06   | SCE     | 16%        | -                            | 3%  | 6%      | 3%      |
| cz07   | SDG&E   | 21%        | -                            | 9%  | 13%     | 9%      |
| cz08   | SCE     | TBD        | -                            | -   | -       | -       |
| cz09   | SCE     | TBD        | -                            | TBD | TBD     | TBD     |
| cz10   | SDG&E   | TBD        | -                            | -   | -       | -       |
| cz10-2 | SCE     | TBD        | -                            | -   | -       | -       |
| cz11   | PG&E    | TBD        | -                            | TBD | TBD     | TBD     |
| cz12   | PG&E    | TBD        | -                            | TBD | TBD     | TBD     |
| cz12-2 | SMUD    | TBD        | -                            | TBD | TBD     | TBD     |
| cz13   | PG&E    | 7%         | -                            | TBD | TBD     | TBD     |
| cz14   | SDG&E   | TBD        | -                            | TBD | TBD     | TBD     |
| cz14-2 | SCE     | TBD        | -                            | TBD | TBD     | TBD     |
| cz15   | SCE     | TBD        | -                            | TBD | TBD     | TBD     |
| cz16   | PG&E    | TBD        | -                            | -   | TBD     | -       |

| Cell Color |  | Cell Value |  |
|------------|--|------------|--|
|            | Cost effective on both TDV/On-Bill metrics   | X%         | EffTDV Compliance Margin percentages (Lowest common)   |
|            | Cost effective on either TDV/On-Bill metrics |            | Compliant on both Manual and Software output approaches  |
|            | Compliant, not cost effective                | TBD        | Likely to comply with future modeling updates or software versions, maybe compliant on either Manual or Software output approach |
|            | Not compliant nor cost effective             | -          | Not compliant on either approach   |

The Reach Code Team analyzed a completely all-electric package including cooking appliances, results shown in Table 20, which show compliance in many climate zones with added efficiency and load flexibility. Remaining CZs are “TBD”, except climate zone 16, which comply on either one of the Manual or Software output approaches currently and are likely to show compliance with future modeling updates. However, the all-electric package is cost-effective in CZ4 CPAU territory only and very close to being cost-effective in SMUD territory. Cooking electrification is expensive and challenging to show cost-effective.

**Table 20. Cost-effectiveness and Compliance Summary – Quick-Service Restaurant (with cooking electrification)**

| CZ     | Utility | All-electric |     |         |
|--------|---------|--------------|-----|---------|
|        |         | Code Min     | EE  | EE + LF |
| cz01   | PG&E    | -            | 6%  | 15%     |
| cz02   | PG&E    | -            | TBD | 2%      |
| cz03   | PG&E    | -            | 10% | 14%     |
| cz04   | PG&E    | -            | 8%  | 10%     |
| cz04-2 | CPAU    | -            | 8%  | 10%     |
| cz05   | PG&E    | -            | 10% | 17%     |
| cz05-2 | SCG     | -            | 10% | 17%     |
| cz06   | SCE     | -            | 6%  | 10%     |
| cz07   | SDG&E   | -            | 11% | 14%     |
| cz08   | SCE     | -            | TBD | TBD     |
| cz09   | SCE     | -            | TBD | TBD     |
| cz10   | SDG&E   | -            | TBD | TBD     |
| cz10-2 | SCE     | -            | TBD | TBD     |
| cz11   | PG&E    | -            | TBD | 0%      |
| cz12   | PG&E    | -            | TBD | TBD     |
| cz12-2 | SMUD    | -            | TBD | TBD     |
| cz13   | PG&E    | -            | TBD | TBD     |
| cz14   | SDG&E   | -            | TBD | TBD     |
| cz14-2 | SCE     | -            | TBD | TBD     |
| cz15   | SCE     | -            | TBD | 2%      |
| cz16   | PG&E    | -            | -   | -       |

| Cell Color |  | Cell Value |  |
|------------|--|------------|--|
|            | Cost effective on both TDV/On-Bill metrics   | X%         | EffTDV Compliance Margin percentages (Lowest common)   |
|            | Cost effective on either TDV/On-Bill metrics |            | Compliant on both Manual and Software output approaches  |
|            | Compliant, not cost effective                | TBD        | Likely to comply with future modeling updates or software versions, maybe compliant on either Manual or Software output approach |
|            | Not compliant nor cost effective             | -          | Not compliant on either approach   |

## 5.4 Small Hotel

The Team analyzed EE package over mixed fuel baseline and three electrification packages - Code Min, EE, EE+PV, with results in Table 21.

- Results support reach code adoption for energy efficiency measures over mixed fuel baseline, also known as “Electric-Preferred” reach code pathway with 2-5% compliance margin.
- All-electric packages with efficiency measures and/or solar PV in most CZs are cost-effective and likely to be compliant in future with modeling and/or software version updates. Some climate zones are compliant currently across either one of the Manual or Software output approaches.
- All all-electric scenarios are labeled as “TBD” because 36% of conditioned floor area is nonresidential space and has the same system type limitation as Medium Office (see Section 5.1). Hence, the Small Hotel will be re-evaluated as well with a central heat pump boiler system instead of electric resistance VAV system in early 2023. The current results show compliance on either one of the Manual or Software output approaches in some climate zones with efficiency measures and solar PV, still labeled as “TBD” until the software inconsistencies are resolved.

**Table 21. Cost-effectiveness and Compliance Summary – Small Hotel.**

| CZ     | Utility | Mixed Fuel | All-electric |     |         |
|--------|---------|------------|--------------|-----|---------|
|        |         | EE         | Code Min     | EE  | EE + PV |
| cz01   | PG&E    | 5%         | TBD          | TBD | TBD     |
| cz02   | PG&E    | 4%         | TBD          | TBD | TBD     |
| cz03   | PG&E    | 5%         | TBD          | TBD | TBD     |
| cz04   | PG&E    | 5%         | TBD          | TBD | TBD     |
| cz04-2 | CPAU    | 5%         | TBD          | TBD | TBD     |
| cz05   | PG&E    | 5%         | TBD          | TBD | TBD     |
| cz05-2 | SCG     | 5%         | TBD          | TBD | TBD     |
| cz06   | SCE     | 5%         | TBD          | TBD | TBD     |
| cz07   | SDG&E   | 4%         | TBD          | TBD | TBD     |
| cz08   | SCE     | 5%         | TBD          | TBD | TBD     |
| cz09   | SCE     | 5%         | TBD          | TBD | TBD     |
| cz10   | SDG&E   | 5%         | TBD          | TBD | TBD     |
| cz10-2 | SCE     | 5%         | TBD          | TBD | TBD     |
| cz11   | PG&E    | 3%         | TBD          | TBD | TBD     |
| cz12   | PG&E    | 4%         | TBD          | TBD | TBD     |
| cz12-2 | SMUD    | 4%         | TBD          | TBD | TBD     |
| cz13   | PG&E    | 3%         | TBD          | TBD | TBD     |
| cz14   | SDG&E   | 4%         | TBD          | TBD | TBD     |
| cz14-2 | SCE     | 4%         | TBD          | TBD | TBD     |
| cz15   | SCE     | 5%         | TBD          | TBD | TBD     |
| cz16   | PG&E    | 2%         | TBD          | TBD | TBD     |

| Cell Color |  | Cell Value |   |
|------------|--|------------|---|
|            | Cost effective on both TDV/On-Bill metrics   | x%         | EffTDV Compliance Margin percentages (Lowest common)<br>Compliant on both Manual and Software output approaches                     |
|            | Cost effective on either TDV/On-Bill metrics | TBD        | Likely to comply with future modeling updates or software versions,<br>maybe compliant on either Manual or Software output approach |
|            | Compliant, not cost effective                | -          | Not compliant on either approach  |
|            | Not compliant nor cost effective             |            |   |

The Team analyzed an additional scenario that proposes PTHP compared to the same SZAC mixed fuel baseline model, results shown in Table 22. Though PTHP is a much cheaper alternative than SZHP, it is not compliant by itself.

**Table 22. Cost-effectiveness and Compliance Summary – Small Hotel (PTHP)**

| CZ     | Utility | All-electric<br>Code Min<br>(PTHP) |
|--------|---------|------------------------------------|
|        |         |                                    |
| cz01   | PG&E    | -                                  |
| cz02   | PG&E    | -                                  |
| cz03   | PG&E    | -                                  |
| cz04   | PG&E    | -                                  |
| cz04-2 | CPAU    | -                                  |
| cz05   | PG&E    | -                                  |
| cz05-2 | SCG     | -                                  |
| cz06   | SCE     | -                                  |
| cz07   | SDG&E   | TBD                                |
| cz08   | SCE     | TBD                                |
| cz09   | SCE     | TBD                                |
| cz10   | SDG&E   | -                                  |
| cz10-2 | SCE     | -                                  |
| cz11   | PG&E    | -                                  |
| cz12   | PG&E    | -                                  |
| cz12-2 | SMUD    | -                                  |
| cz13   | PG&E    | -                                  |
| cz14   | SDG&E   | -                                  |
| cz14-2 | SCE     | -                                  |
| cz15   | SCE     | -                                  |
| cz16   | PG&E    | -                                  |

| Cell Color |  | Cell Value |   |
|------------|--|------------|---|
|            | Cost effective on both TDV/On-Bill metrics   | x%         | EffTDV Compliance Margin percentages (Lowest common)<br>Compliant on both Manual and Software output approaches                     |
|            | Cost effective on either TDV/On-Bill metrics | TBD        | Likely to comply with future modeling updates or software versions,<br>maybe compliant on either Manual or Software output approach |
|            | Compliant, not cost effective                | -          | Not compliant on either approach  |
|            | Not compliant nor cost effective             |            |   |

## 6 Conclusions

The Reach Code Team developed a variety of packages involving fuel substitution, energy efficiency, load flexibility, and solar PV, simulated them in building modeling software, and gathered costs to determine the cost-effectiveness of multiple scenarios. The Team coordinated with multiple utilities, cities, and building community experts to develop a set of assumptions considered reasonable in the current market. Changing assumptions, such as the period of analysis, measure selection, fuel costs, other costs, energy escalation rates, software or utility tariffs may change the results.

These results, including the attached Reach Code Results Workbook, indicate all-electric packages are capable of achieving the greatest GHG savings as compared to mixed-fuel buildings, see Appendix 8.5. Jurisdictions may adopt a variety of reach codes such as “Energy Efficiency”, “Electric-Preferred”, “All-Electric” or “All-Electric + Efficiency.” In summary:

- The Reach Code Team has identified a cost-effective and code compliant energy efficiency measure package for most prototypes and climate zones analyzed, which supports an “Electric-Preferred” and/or “Energy Efficiency” reach code pathways for jurisdictions.
- “All-Electric” reach codes are feasible for all building types and climate zones when Part 11 is modified, including some exceptions.
  - All-electric HVAC consisting of packaged single zone systems, including rooftop units in the Medium Retail and Quick-Service Restaurant, and single zone heat pumps in the Small Hotel guest rooms, are widely shown to be cost-effective and energy code compliant, with exceptions in CZs 1 and 16.
  - All-electric SHW systems have a prescriptive pathway for all building types and have not been shown to be an impediment to cost-effectiveness or energy code compliance of all-electric packages in this study.
  - All-electric laundry in the Small Hotel can be cost-effective with added energy efficiency and additional solar PV than required prescriptively by 2022 Title 24 code.
  - Medium Office all-electric packages are cost-effective with energy efficiency and load flexibility measures, but not code compliant due to the use of electric resistance VAV reheat systems. The Small Hotel faces a similar issue for its smaller nonresidential area HVAC systems in some climate zones. This indicates that further efficiency measures would need to be added to achieve energy code compliance which may not be cost-effective. As described in Sections 5.1 and 5.4, modeling limitations impacted the code compliance results for the medium office and nonresidential portion of the small hotel. These prototypes will be re-evaluated using a more appropriate central heat pump boiler HVAC system, likely available in compliance software in early 2023. In the meantime, jurisdictions can choose to exempt building systems that do not have a prescriptive compliance pathway in the energy code. See Berkeley’s all-electric ordinance (Berkeley 2019) section 12.80.040.A Exception 1 for an example.
- Commercial kitchen electrification is challenging to design cost-effectively currently. These results align with a previous study focusing on restaurants (Statewide IOU Team 2022). Jurisdictions may choose to exempt cooking appliances until cost-effectiveness factors improve. See Menlo Park’s ordinance (Menlo Park 2019) 100.0(e)2.A Exception 4 for an example.
- For the Medium Retail prototype in CZs 2 to 15, there is already a prescriptive pathway to comply with packaged single zone heat pumps in smaller (<240 kBtuh) thermal zones. This study supports an “All-Electric + Efficiency” reach code pathway for many climates. However, mixed-fuel scenarios with SZAC and gas furnaces for larger (>240 kBtuh) thermal zones are challenging to show cost-effectiveness and/or code compliance, except for climate zones 7 and 9, when including efficiency measures.

Further discussion is required at the jurisdiction and community members to review results and determine appropriate reach code pathways. Please refer to the limitations of this study, described in Section 2.5, while using them to inform reach code policies. Of note:

- The Team employed several CBECC ruleset modifications to support achieving cost-effective packages, especially load flexibility measures. Ruleset modifications cannot be used by the building industry for code compliance without supporting justification or alternate methods. Where jurisdictions want to encourage the adoption of Load Flexibility measures through modeling estimates, the Reach Code Team can support cities and building applicants by providing modeling approximations that may achieve similar energy and compliance total impacts, in coordination with the Energy Commission. For example, for the Demand Response Lighting measure, the Team may be able to share a TDV/ft<sup>2</sup> impact of the measure in that climate zone or provide guidance to the building applicant's energy consultant on appropriate modeling and documentation.
- Results are predominantly based on the code compliance metrics that are manually calculated based on the mixed fuel baseline model and not the standard design model assumed by the current software version. The Team also provided software reported compliance metrics in the workbook for reference. The Team is in communication with software development team to resolve differences in future iterations of this study and the software and improve code compliance reporting.

Even considering the limitations, this study has identified a set of reach code pathways for all climate zones, and jurisdictions have broad discretion on how to interpret the study's findings. Jurisdictions can adopt reach codes requiring energy efficiency via a Title 24 Part 6 local amendment, or electrification via a Title 24 Part 11 (or municipal code) amendment, or both. Jurisdictions may choose to except particular building systems from certain reach codes pathways.

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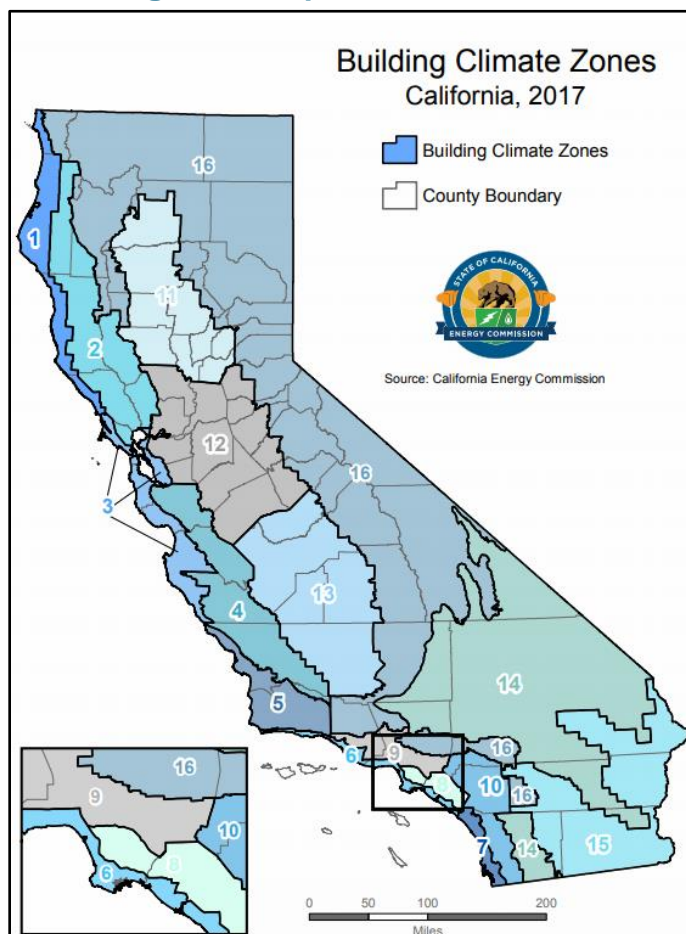
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## 8 Appendices

### 8.1 Map of California CZs

Climate Zone geographical boundaries are depicted in Figure 5 below. An interactive GIS location based map and zip-code based search directory is available at: [Climate Zone tool, maps, and information supporting the California Energy Code](#)

**Figure 5. Map of California CZs**



## 8.2 Utility Rate Schedules

The Reach Codes Team used the IOU and POU rates depicted in to determine the On-Bill savings for each prototype.

**Table 23. Utility Tariffs Analyzed Based on CZ – Detailed View**

| CZs    | Utility | Electric Rate (Time of Use) |                      |                      |                      | Gas Rate       |
|--------|---------|-----------------------------|----------------------|----------------------|----------------------|----------------|
|        |         | Medium Office               | Medium Retail        | QSR                  | Small Hotel          | All Prototypes |
| CZ01   | PG&E    | B-10                        | B-1                  | B-1                  | B-1 or B-10          | G-NR1          |
| CZ02   | PG&E    | B-10                        | B-1 or B-10          | B-1 or B-10          | B-1 or B-10          | G-NR1          |
| CZ03   | PG&E    | B-10                        | B-1                  | B-1                  | B-1 or B-10          | G-NR1          |
| CZ04   | PG&E    | B-10                        | B-1 or B-10          | B-1 or B-10          | B-1 or B-10          | G-NR1          |
| CZ04-2 | CPAU    | E-2                         | E-2                  | E-2                  | E-2                  | G-2            |
| CZ05   | PG&E    | B-10                        | B-1                  | B-1                  | B-1 or B-10          | G-NR1          |
| CZ05-2 | SCG     | B-10                        | B-1                  | B-1                  | B-1 or B-10          | G-10 (GN-10)   |
| CZ06   | SCE     | TOU-GS-2                    | TOU-GS-2             | TOU-GS-2             | TOU-GS-2             | G-10 (GN-10)   |
| CZ07   | SDG&E   | AL-TOU+EECC (AL-TOU)        | AL-TOU+EECC (AL-TOU) | AL-TOU+EECC (AL-TOU) | AL-TOU+EECC (AL-TOU) | GN-3           |
| CZ08   | SCE     | TOU-GS-2                    | TOU-GS-2             | TOU-GS-2             | TOU-GS-2             | G-10 (GN-10)   |
| CZ09   | SCE     | TOU-GS-2                    | TOU-GS-2             | TOU-GS-2             | TOU-GS-2             | G-10 (GN-10)   |
| CZ10   | SDG&E   | AL-TOU+EECC (AL-TOU)        | AL-TOU+EECC (AL-TOU) | AL-TOU+EECC (AL-TOU) | AL-TOU+EECC (AL-TOU) | G-10 (GN-10)   |
| CZ10-2 | SCE     | TOU-GS-2                    | TOU-GS-2             | TOU-GS-2             | TOU-GS-2             | GN-3           |
| CZ11   | PG&E    | B-10                        | B-10                 | B-1 or B-10          | B-10                 | G-NR1          |
| CZ12   | PG&E    | B-10                        | B-1 or B-10          | B-1 or B-10          | B-10                 | G-NR1          |
| CZ12-2 | SMUD    | CITS-1 (CI-TOD 1)           | CITS-1 (CI-TOD 1)    | CITS-1 (CI-TOD 1)    | CITS-1               | G-NR1          |
| CZ13   | PG&E    | B-10                        | B-10                 | B-1 or B-10          | B-10                 | G-NR1          |
| CZ14   | SDG&E   | AL-TOU+EECC (AL-TOU)        | AL-TOU+EECC (AL-TOU) | AL-TOU+EECC (AL-TOU) | AL-TOU+EECC (AL-TOU) | G-10 (GN-10)   |
| CZ14-2 | SCE     | TOU-GS-2                    | TOU-GS-2             | TOU-GS-2             | TOU-GS-2 or TOU-GS-3 | GN-3           |
| CZ15   | SCE     | TOU-GS-2                    | TOU-GS-2             | TOU-GS-2             | TOU-GS-2             | G-10 (GN-10)   |
| CZ16   | PG&E    | B-10                        | B-1 or B-10          | B-1 or B-10          | B-1 or B-10          | G-NR1          |

## 8.2.1 PG&E

Figure 6. PG&E Electric Schedule - B-1

**Pacific Gas and  
Electric Company**

U 39

San Francisco, California

Cancelling Revised  
Revised

Cal. P.U.C. Sheet No. 53377-E  
Cal. P.U.C. Sheet No. 52618-E

**ELECTRIC SCHEDULE B-1  
SMALL GENERAL SERVICE**

Sheet 3

**RATES:** Total bundled service charges are calculated using the total rates shown below. Direct Access (DA) and Community Choice Aggregation (CCA) charges shall be calculated in accordance with the paragraph in this rate schedule titled Billing.

| <u>Total Bundled Time-of-Use Rates</u>   | <u>B-1 Rates</u> | <u>B1-ST Rates</u> | (T)           |
|--|------------------|--------------------|---------------|
| <u>Total Customer Charge Rates</u>   |                  |                    |               |
| Customer Charge Single-phase<br>(\$ per meter per day)                                 | \$0.32854        | \$0.32854          |               |
| Customer Charge Poly-phase<br>(\$ per meter per day)                                   | \$0.82136        | \$0.82136          |               |
| <u>Demand Charge (for B1-ST only)</u>  |                  |                    |               |
| Total Demand Rate (per metered kW/month<br>assessed from 2:00 p.m. to 11:00 p.m. only) |                  |                    |               |
| Summer   | ---              | \$4.75             | (I)           |
| Winter   | ---              | \$4.75             | (I)           |
| <u>Total TOU Energy Rates (\$ per kWh)</u>   |                  |                    |               |
| Peak Summer  | \$0.38827        | (I)                | \$0.44884 (I) |
| Part-Peak Summer   | \$0.33904        | (I)                | \$0.30754 (I) |
| Off-Peak Summer  | \$0.31824        | (I)                | \$0.26021 (I) |
| Peak Winter  | \$0.31285        | (I)                | \$0.35089 (I) |
| Partial-Peak Winter (for B1-ST only)   | ---              |                    | \$0.32139 (I) |
| Off-Peak Winter  | \$0.29674        | (I)                | \$0.23234 (I) |
| Super Off-Peak Winter  | \$0.28032        | (I)                | \$0.21592 (I) |
| <u>PDP Rates (Consecutive Day and Five-Hour<br/>Event Option)*</u>                     |                  |                    |               |
| PDP Charges (\$ per kWh)   |                  |                    |               |
| All Usage During PDP Event   | \$0.60           |                    |               |
| PDP Credits  |                  |                    |               |
| Energy (\$ per kWh)  |                  |                    |               |
| Peak Summer  | (\$0.05687)      |                    |               |
| Part-Peak Summer   | (\$0.01683)      |                    |               |

\* See PDP Detail, section g, for corresponding reduction in PDP credits and charges if other option(s) elected.

(Continued)

|          |          |                                    |            |              |
|----------|----------|------------------------------------|------------|--------------|
| Advice   | 6603-E-A | Issued by                          | Submitted  | May 31, 2022 |
| Decision |          | Robert S. Kenney                   | Effective  | June 1, 2022 |
|          |          | Vice President, Regulatory Affairs | Resolution |              |

Figure 7. PG&E Electric Schedule - B-10

**Pacific Gas and  
Electric Company®**

U 39

San Francisco, California

Cancelling Revised Cal. P.U.C. Sheet No. 53381-E  
Revised Cal. P.U.C. Sheet No. 52969-E

**ELECTRIC SCHEDULE B-10  
MEDIUM GENERAL DEMAND-METERED SERVICE**

Sheet 3

**RATE:**

Total bundled service charges shown on customers' bills are unbundled according to the component rates shown below. 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 TIME-OF-USE RATES**

(T)

|   | Secondary<br>Voltage | Primary<br>Voltage | Transmission<br>Voltage |
|---|----------------------|--------------------|-------------------------|
| <u>Total Customer Charge Rates</u>                                |                      |                    |                         |
| Customer Charge<br>(\$ per meter per day)                         | \$8.42016 (I)        | \$8.42016 (I)      | \$8.42016 (I)           |
| <u>Total Demand Rates (\$ per kW)</u>                             |                      |                    |                         |
| Summer  | \$17.47 (I)          | \$17.19 (I)        | \$13.66 (I)             |
| Winter  | \$17.47 (I)          | \$17.19 (I)        | \$13.66 (I)             |
| <u>Total Energy Rates (\$ per kWh)</u>                            |                      |                    |                         |
| Peak Summer   | \$0.31411 (I)        | \$0.29823 (I)      | \$0.23025 (I)           |
| Part-Peak Summer  | \$0.25242 (I)        | \$0.23993 (I)      | \$0.17351 (I)           |
| Off-Peak Summer   | \$0.21985 (I)        | \$0.20909 (I)      | \$0.14344 (I)           |
| Peak Winter   | \$0.23784 (I)        | \$0.22538 (I)      | \$0.17720 (I)           |
| Off-Peak Winter   | \$0.20236 (I)        | \$0.19174 (I)      | \$0.14436 (I)           |
| Super Off-Peak Winter   | \$0.16802 (I)        | \$0.15540 (I)      | \$0.10802 (I)           |
| <u>PDP Rates (Consecutive Day and Five-Hour<br/>Event Option)</u> |                      |                    |                         |
| <u>PDP Charges (\$ per kWh)</u>                                   |                      |                    |                         |
| All Usage During PDP Event  | \$0.90               | \$0.90             | \$0.90                  |
| <u>PDP Credits<br/>Energy (\$ per kWh)</u>                        |                      |                    |                         |
| Peak Summer   | (\$0.07825)          | (\$0.07825)        | (\$0.07825)             |
| Part-Peak Summer  | (\$0.02710)          | (\$0.02710)        | (\$0.02710)             |

\* See PDP Details, section g, for corresponding reduction in PDP credits and charges if other option(s) elected.

(Continued)

Advice Decision 6603-E-A

Issued by  
Robert S. Kenney  
Vice President, Regulatory Affairs

Submitted  
Effective  
Resolution

May 31, 2022  
June 1, 2022

Figure 8. PG&E Gas Schedule – G-NR1

## Core Commercial Gas Rates

Rates below are effective October 1, 2022, through October 31, 2022.

**Small Commercial: Schedule G-NR1** (Usage less than 20,800 therms per month)\*

|  | HIGHEST AVERAGE DAILY USAGE** |                       |                       |                        |                      |
|--|-------------------------------|-----------------------|-----------------------|------------------------|----------------------|
|  | 0 - 5.0<br>THERMS             | 5.1 - 16.0<br>THERMS  | 16.1 - 41.0<br>THERMS | 41.1 - 123.0<br>THERMS | 123.1 & UP<br>THERMS |
| Customer Charge (per day)  | \$0.27048                     | \$0.52106             | \$0.95482             | \$1.66489              | \$2.14936            |
|  |                               | PER THERM             |                       |                        |                      |
|  |                               | SUMMER                |                       | WINTER                 |                      |
|  |                               | FIRST 4,000<br>THERMS | EXCESS<br>THERMS      | FIRST 4,000<br>THERMS  | EXCESS<br>THERMS     |
| Procurement Charge (per therm)   |                               | \$0.87890             | \$0.87890             | \$0.87890              | \$0.87890            |
| Transportation Charge (per therm)  |                               | \$0.93090             | \$0.58273             | \$1.09498              | \$0.68545            |
| <b>Total G-NR1 Schedule Charge <sup>1/</sup></b>                             |                               | <b>\$1.80980</b>      | <b>\$1.46163</b>      | <b>\$1.97388</b>       | <b>\$1.56435</b>     |
| Cap-and-Trade Cost Exemption Credit <sup>2/</sup>                            |                               | \$0.10235             |                       |                        |                      |
| Schedule G-PPPS (Public Purpose Program Surcharge) <sup>1/</sup> (per therm) |                               | \$0.06237             | \$0.06237             | \$0.06237              | \$0.06237            |

\*Excluding months during which usage is less than 200 therms.

\*\*Based on customer's highest Average Daily Usage (ADU) determined from among the billing periods occurring within the last twelve months, including current billing period. PG&E calculates the ADU for each billing period by dividing the total usage by the number of days in the billing period.

## 8.2.2 SCE

Figure 9. SCE Electric Schedule – TOU-GS-1

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

Revised Cal. PUC Sheet No. 74535-E  
Cancelling Revised Cal. PUC Sheet No. 73990-E

Schedule TOU-GS-1  
TIME-OF-USE  
GENERAL SERVICE  
(Continued)

Sheet 5

RATES (Continued)

| Option D   | Delivery Service   |                      |                   |                  |                   |                  |                    |                    | Generation <sup>9</sup> |                 |                     |
|--|--------------------|----------------------|-------------------|------------------|-------------------|------------------|--------------------|--------------------|-------------------------|-----------------|---------------------|
|  | Trans <sup>1</sup> | Distrib <sup>2</sup> | NSGC <sup>3</sup> | NDC <sup>4</sup> | PPPC <sup>5</sup> | WFC <sup>6</sup> | DWRA <sup>11</sup> | PUCRF <sup>7</sup> | Total <sup>8</sup>      | UG <sup>9</sup> | DWREC <sup>10</sup> |
| Energy Charge - \$/kWh                               |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| Summer Season On-Peak                                | (0.00039)          | 0.03298 (R)          | 0.00967 (R)       | 0.00010          | 0.01845 (R)       | 0.00952          | (0.00208)          | 0.00130            | 0.06625 (R)             | 0.11330 (I)     | 0.00000             |
| Mid-Peak   | (0.00039)          | 0.03298 (R)          | 0.00967 (R)       | 0.00010          | 0.01845 (R)       | 0.00952          | (0.00208)          | 0.00130            | 0.06625 (R)             | 0.10231 (I)     | 0.00000             |
| Off-Peak   | (0.00039)          | 0.01374 (I)          | 0.00967 (R)       | 0.00010          | 0.01845 (R)       | 0.00952          | (0.00208)          | 0.00130            | 0.04731 (I)             | 0.06705 (I)     | 0.00000             |
| Winter Season  |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| Mid-Peak   | (0.00039)          | 0.03298 (R)          | 0.00967 (R)       | 0.00010          | 0.01845 (R)       | 0.00952          | (0.00208)          | 0.00130            | 0.06625 (R)             | 0.10988 (I)     | 0.00000             |
| Off-Peak   | (0.00039)          | 0.01374 (I)          | 0.00967 (R)       | 0.00010          | 0.01845 (R)       | 0.00952          | (0.00208)          | 0.00130            | 0.04731 (I)             | 0.07551 (R)     | 0.00000             |
| Super-Off-Peak                                       | (0.00039)          | 0.00520 (R)          | 0.00967 (R)       | 0.00010          | 0.01845 (R)       | 0.00952          | (0.00208)          | 0.00130            | 0.03877 (R)             | 0.05654 (R)     | 0.00000             |
| Fixed Recovery Charge - \$/kWh                       |                    |                      |                   |                  |                   |                  |                    |                    | 0.00086 (I)             |                 |                     |
| Customer Charge - \$/day                             |                    |                      |                   |                  |                   |                  |                    |                    | 0.488 (R)               |                 |                     |
| Facilities Related Demand Charge - \$/kW             |                    |                      |                   |                  |                   |                  |                    |                    | 13.16 (I)               |                 |                     |
| Time Related Demand Charge - \$/kW                   |                    |                      |                   |                  |                   |                  |                    |                    |                         | 15.97 (I)       |                     |
| Summer Season On-Peak                                |                    | 3.80 (R)             |                   |                  |                   |                  |                    |                    | 3.80 (R)                | 15.97 (R)       |                     |
| Winter Season  |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| Mid-peak - Weekdays (4-4pm)                          |                    | 0.00                 |                   |                  |                   |                  |                    |                    | 0.00                    | 4.90 (I)        |                     |
| Three-Phase Service - \$/day                         |                    |                      |                   |                  |                   |                  |                    |                    | 0.048 (I)               |                 |                     |
| Voltage Discount, Energy - \$/kWh                    |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| From 2 kV to 50 kV                                   | 0.00000            | 0.00000 (R)          |                   |                  |                   |                  |                    |                    | 0.00000 (R)             | (0.00045) (R)   |                     |
| From 51 kV to 219 kV                                 | 0.00000            | 0.00000 (R)          |                   |                  |                   |                  |                    |                    | 0.00000 (R)             | (0.00066) (R)   |                     |
| 220 kV and above                                     | 0.00000            | (0.01843) (R)        |                   |                  |                   |                  |                    |                    | (0.01843) (R)           | (0.00062) (R)   |                     |
| Voltage Discount, Demand - \$/kW                     |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| Facilities Related                                   |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| From 2 kV to 50 kV                                   | 0.00               | (0.26) (I)           |                   |                  |                   |                  |                    |                    | (0.26) (I)              |                 |                     |
| Above 50 kV but below 220 kV                         | 0.00               | (5.78) (R)           |                   |                  |                   |                  |                    |                    | (5.78) (R)              |                 |                     |
| At 220 kV  | 0.00               | (13.16) (I)          |                   |                  |                   |                  |                    |                    | (13.16) (I)             |                 |                     |
| Voltage Discount, Summer On Peak Demand - \$/kW      |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| From 2 kV to 50 kV                                   |                    | (0.08) (I)           |                   |                  |                   |                  |                    |                    | (0.08) (I)              | (0.20)          |                     |
| Above 50 kV but below 220 kV                         |                    | (1.44) (I)           |                   |                  |                   |                  |                    |                    | (1.44) (I)              | (0.47)          |                     |
| At 220 kV  |                    | (1.44) (R)           |                   |                  |                   |                  |                    |                    | (1.44) (R)              | (0.47)          |                     |
| Voltage Disc, Winter Weekdays (4-4pm) Demand - \$/kW |                    |                      |                   |                  |                   |                  |                    |                    |                         |                 |                     |
| From 2 kV to 50 kV                                   |                    | 0.00                 |                   |                  |                   |                  |                    |                    | 0.00                    | (0.20)          |                     |
| Above 50 kV but below 220 kV                         |                    | 0.00                 |                   |                  |                   |                  |                    |                    | 0.00                    | (0.47)          |                     |
| At 220 kV  |                    | 0.00                 |                   |                  |                   |                  |                    |                    | 0.00                    | (0.47)          |                     |
| California Alternate Rates for Energy Discount - %   |                    |                      |                   |                  |                   |                  |                    |                    | 100.00*                 |                 |                     |
| California Climate Credit - \$/meter                 |                    |                      |                   |                  |                   |                  |                    |                    | (50.00)                 |                 |                     |

\* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.  
\*\* The ongoing Competition Transition Charge (CTC) of \$(0.00015) per kWh is recovered in the UG component of Generation.  
1 Trans - Transmission and the Transmission Owners Tariff Charge Adjustments (TOTCA) which are FERC approved. The TOTCA represents the Transmission Revenue Balancing Account Adjustment (TRBAA) of \$(0.00141) per kWh, Reliability Services Balancing Account Adjustment (RSBAA) of \$(0.00087) per kWh, and Transmission Access Charge Balancing Account Adjustment (TACBAA) of \$0.00189 per kWh  
2 Distribn - Distribution  
3 NSGC - New System Generation Charge  
4 NDC - Nuclear Decommissioning Charge  
5 PPPC - Public Purpose Programs Charge (includes California Alternate Rates for Energy Surcharge where applicable.)  
6 WFC - Wildfire Fund Non-Bypassable Charge. The Wildfire Fund Non-Bypassable Charge supports the California Wildfire Fund and is not applicable to exempt Customers pursuant to D.19-10-056.  
7 PUCRF - The PUC Reimbursement Fee is described in Schedule RF-E.  
8 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.  
9 Generation - The Generation rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.  
10 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.  
11 DWRA - A refund from the California Department of Water Resources (DWR) relating to the purchase of power during the 2000-2001 energy crisis.

(Continued)

(To be inserted by utility)  
Advice 4864-E  
Decision 22-08-001

Issued by  
Michael Backstrom  
Vice President

(To be inserted by Cal. PUC)  
Date Submitted Sep 15, 2022  
Effective Oct 1, 2022  
Resolution

8C11

Figure 10. SCE Electric Schedule – TOU-GS-2



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

Revised Cal. PUC Sheet No. 74551-E  
Cancelling Revised Cal. PUC Sheet No. 74003-E

**Schedule TOU-GS-2**  
**TIME-OF-USE - GENERAL SERVICE - DEMAND METERED**

Sheet 4

(Continued)

**RATES (Continued)**

|  |                          | Delivery Service             |             |               |         |             |         |           |         | Generation*   |               |         |
|--|--------------------------|------------------------------|-------------|---------------|---------|-------------|---------|-----------|---------|---------------|---------------|---------|
| Option D / Option D-CPP                            |                          | Trans*                       | Distribn*   | NSGC*         | NDC*    | PPPC*       | WFC*    | DWRA**    | PUCRF** | Total*        | UG**          | DWREC** |
| TOU Pricing  | Summer Season - On-Peak  | (0.00012)                    | 0.01503 (R) | 0.00940 (R)   | 0.00010 | 0.01919 (R) | 0.00062 | (0.00200) | 0.00130 | 0.04994 (R)   | 0.10901 (R)   | 0.00000 |
|  | Mid-Peak                 | (0.00012)                    | 0.01433 (R) | 0.00940 (R)   | 0.00010 | 0.01919 (R) | 0.00062 | (0.00200) | 0.00130 | 0.04854 (R)   | 0.09921 (R)   | 0.00000 |
|  | Off-Peak                 | (0.00012)                    | 0.01403 (R) | 0.00940 (R)   | 0.00010 | 0.01919 (R) | 0.00062 | (0.00200) | 0.00130 | 0.04834 (R)   | 0.09365 (R)   | 0.00000 |
|  | Winter Season - Mid-Peak | (0.00012)                    | 0.01503 (R) | 0.00940 (R)   | 0.00010 | 0.01919 (R) | 0.00062 | (0.00200) | 0.00130 | 0.04994 (R)   | 0.07345 (R)   | 0.00000 |
|  | Off-Peak                 | (0.00012)                    | 0.01433 (R) | 0.00940 (R)   | 0.00010 | 0.01919 (R) | 0.00062 | (0.00200) | 0.00130 | 0.04854 (R)   | 0.07369 (R)   | 0.00000 |
|  | Super-Off-Peak           | (0.00012)                    | 0.01359 (R) | 0.00940 (R)   | 0.00010 | 0.01919 (R) | 0.00062 | (0.00200) | 0.00130 | 0.04790 (R)   | 0.05879 (R)   | 0.00000 |
| Fixed Recovery Charge - \$/kWh                     |                          |                              |             |               |         |             |         |           |         | 0.00099 (R)   |               |         |
| Customer Charge - \$/Meter/Month                   |                          |                              | 199.75 (R)  |               |         |             |         |           |         | 199.75 (R)    |               |         |
| Facilities Related Demand Charge - \$/kW           |                          | 5.14                         | 16.40 (R)   |               |         |             |         |           |         | 21.82 (R)     |               |         |
| Time Related Demand Charge - Summer Season - \$/kW |                          | On-Peak                      | 13.63 (R)   |               |         |             |         |           |         | 13.63 (R)     | 20.20 (R)     |         |
| Winter Season - \$/kW                              |                          | Mid-peak - Weekdays (4-9pm)  | 2.20 (R)    |               |         |             |         |           |         | 2.20 (R)      | 5.30 (R)      |         |
| Single Phase Service - \$/Month                    |                          |                              | (6.58) (R)  |               |         |             |         |           |         | (6.58) (R)    |               |         |
| Voltage Discount, Demand - \$/kW                   |                          | Facilities Related           |             |               |         |             |         |           |         |               |               |         |
|  |                          | From 2 kV to 50 kV           | 0.00        | (0.33) (R)    |         |             |         |           |         | (0.33) (R)    | 0.00          |         |
|  |                          | Above 50 kV but below 220 kV | 0.00        | (7.24) (R)    |         |             |         |           |         | (7.24) (R)    | 0.00          |         |
|  |                          | At 220 kV                    | 0.00        | (16.40) (R)   |         |             |         |           |         | (16.40) (R)   | 0.00          |         |
| Voltage Discount, Summer On-Peak - \$/kW           |                          | From 2 kV to 50 kV           | 0.00        | (0.27) (R)    |         |             |         |           |         | (0.27) (R)    | (0.48) (R)    |         |
|  |                          | Above 50 kV but below 220 kV | 0.00        | (5.15) (R)    |         |             |         |           |         | (5.15) (R)    | (1.06) (R)    |         |
|  |                          | At 220 kV                    | 0.00        | (13.63) (R)   |         |             |         |           |         | (13.63) (R)   | (1.07) (R)    |         |
| Voltage Discount, Winter Weekday Mid-Peak - \$/kW  |                          | From 2 kV to 50 kV           | 0.00        | (0.04) (R)    |         |             |         |           |         | (0.04) (R)    | (0.12) (R)    |         |
|  |                          | Above 50 kV but below 220 kV | 0.00        | (0.83) (R)    |         |             |         |           |         | (0.83) (R)    | (0.26) (R)    |         |
|  |                          | At 220 kV                    | 0.00        | (2.20) (R)    |         |             |         |           |         | (2.20) (R)    | (0.26) (R)    |         |
| Voltage Discount, Energy - \$/kWh                  |                          | From 2 kV to 50 kV           | 0.00000     | (0.00020) (R) |         |             |         |           |         | (0.00020) (R) | (0.00091) (R) |         |
|  |                          | Above 50 kV but below 220 kV | 0.00000     | (0.00494) (R) |         |             |         |           |         | (0.00494) (R) | (0.00197) (R) |         |
|  |                          | At 220 kV                    | 0.00000     | (0.01314) (R) |         |             |         |           |         | (0.01314) (R) | (0.00199) (R) |         |
| California Alternate Rates for Energy Discount - % |                          |                              | 100.00*     |               |         |             |         |           |         | 100.00*       |               |         |
| TOU Option   |                          | \$/Meter/Month               | 26.83       |               |         |             |         |           |         | 26.83         |               |         |
|  |                          | RTM                          | (59.00)     |               |         |             |         |           |         | (59.00)       |               |         |
| California Climate Credit - \$/meter               |                          |                              |             |               |         |             |         |           |         |               |               |         |
| Option D-CPP                                       |                          |                              |             |               |         |             |         |           |         |               |               |         |
| CPP Event Energy Charge - \$/kWh                   |                          |                              |             |               |         |             |         |           |         |               | 0.80000       |         |
| Summer CPP Non-Event Credit                        |                          |                              |             |               |         |             |         |           |         |               |               |         |
| On-Peak Demand Credit - \$/kW                      |                          |                              |             |               |         |             |         |           |         |               | (6.82)        |         |
| Maximum Available Credit - \$/kW**                 |                          |                              |             |               |         |             |         |           |         |               | (20.20) (R)   |         |
|  |                          | Summer (4-9pm)               |             |               |         |             |         |           |         |               |               |         |

- \* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.  
 \*\* The ongoing Competition Transition Charge (CTC) of \$(0.00015) 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 Trans = Transmission and the Transmission Owners Tariff Charge Adjustments (TOTCA) which are FERC approved. The TOTCA represents the Transmission Revenue Balancing Account Adjustment (TRBAA) of \$(0.0141) per kWh, Reliability Services Balancing Account Adjustment (RSBAA) of \$(0.00060) per kWh, and Transmission Access Charge Balancing Account Adjustment (TACBAA) of \$0.00189 per kWh.  
 2 Distribn = Distribution  
 3 NSGC = New System Generation Charge  
 4 NDC = Nuclear Decommissioning Charge  
 5 PPPC = Public Purpose Programs Charge (Includes California Alternate Rates for Energy Surcharge where applicable.)  
 6 WFC = Wildfire Fund Non-Bypassable Charge. The Wildfire Fund Non-Bypassable Charge supports the California Wildfire Fund and is not applicable to exempt Customers pursuant to D.19-10-056.  
 7 PUCRF = The PUC Reimbursement Fee is described in Schedule RF-E.  
 8 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.  
 9 Generation = The Generation rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.  
 10 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.  
 11 DWRA = A refund from the California Department of Water Resources (DWR) relating to the purchase of power during the 2000-2001 energy crisis.

(Continued)

(To be inserted by utility)  
 Advice 4864-E  
 Decision 22-08-001

Issued by  
Michael Backstrom  
 Vice President

(To be inserted by Cal. PUC)  
 Date Submitted Sep 15, 2022  
 Effective Oct 1, 2022  
 Resolution \_\_\_\_\_

4C11

Figure 11. SCE Electric Schedule – TOU-GS-3



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

Revised Cal. PUC Sheet No. 73208-E  
Cancelling Revised Cal. PUC Sheet No. 72721-E

**Schedule TOU-GS-3**  
**TIME-OF-USE - GENERAL SERVICE - DEMAND METERED**

Sheet 3

(Continued)

**RATES (Continued)**

|  | Delivery Service |               |                   |                  |                   |                    |                    | Generation*   |                     |
|--|------------------|---------------|-------------------|------------------|-------------------|--------------------|--------------------|---------------|---------------------|
|  | Trans            | Distribn      | NSGC <sup>3</sup> | NDC <sup>4</sup> | PPPC <sup>5</sup> | DWRBC <sup>6</sup> | PUCRF <sup>7</sup> | UG**          | DWREC <sup>10</sup> |
| <b>Option D / Option D-CPP</b>   |                  |               |                   |                  |                   |                    |                    |               |                     |
| <b>Energy Charge - \$/kWh/Meter/Month</b>  |                  |               |                   |                  |                   |                    |                    |               |                     |
| Summer Season - On-Peak  | 0.00095          | 0.00098 (I)   | 0.00888 (R)       | 0.00010          | 0.01771 (R)       | 0.00652            | 0.00130            | 0.04540 (R)   | 0.10353 (I)         |
| Mid-Peak   | 0.00095          | 0.00098 (I)   | 0.00888 (R)       | 0.00010          | 0.01771 (R)       | 0.00652            | 0.00130            | 0.04540 (R)   | 0.09309 (I)         |
| Off-Peak   | 0.00095          | 0.00098 (I)   | 0.00888 (R)       | 0.00010          | 0.01771 (R)       | 0.00652            | 0.00130            | 0.04540 (R)   | 0.06120 (I)         |
| <b>Winter Season</b>   |                  |               |                   |                  |                   |                    |                    |               |                     |
| Mid-Peak   | 0.00095          | 0.00098 (I)   | 0.00888 (R)       | 0.00010          | 0.01771 (R)       | 0.00652            | 0.00130            | 0.04540 (R)   | 0.06038 (I)         |
| Off-Peak   | 0.00095          | 0.00098 (I)   | 0.00888 (R)       | 0.00010          | 0.01771 (R)       | 0.00652            | 0.00130            | 0.04540 (R)   | 0.06747 (I)         |
| Super-Off-Peak   | 0.00095          | 0.00098 (I)   | 0.00888 (R)       | 0.00010          | 0.01771 (R)       | 0.00652            | 0.00130            | 0.04540 (R)   | 0.04329 (I)         |
| <b>Customer Charge - \$/Meter/Month</b>  |                  |               |                   |                  |                   |                    |                    |               |                     |
| Demand Charge - \$/kW of Billing Demand/Meter/Month                                |                  | 496.98 (I)    |                   |                  |                   |                    |                    | 496.98 (I)    |                     |
| Facilities Related   | 5.65             | 13.29 (I)     |                   |                  |                   |                    |                    | 18.94 (I)     |                     |
| <b>Time Related</b>  |                  |               |                   |                  |                   |                    |                    |               |                     |
| Summer Season - On-Peak  |                  | 16.14 (I)     |                   |                  |                   |                    |                    | 16.14 (I)     | 22.36 (I)           |
| Winter Season - Mid-Peak - Weekdays (4-9pm)  |                  | 5.47 (I)      |                   |                  |                   |                    |                    | 5.47 (I)      | 4.08 (I)            |
| <b>Voltage Discount, Demand - \$/kW</b>  |                  |               |                   |                  |                   |                    |                    |               |                     |
| Facilities Related   |                  |               |                   |                  |                   |                    |                    |               |                     |
| From 2 kV to 50 kV   | 0.00             | (0.19) (I)    |                   |                  |                   |                    |                    | (0.19) (I)    |                     |
| Above 50 kV but below 220 kV   | 0.00             | (8.13) (I)    |                   |                  |                   |                    |                    | (8.13) (I)    |                     |
| At 220 kV  | 0.00             | (13.29) (I)   |                   |                  |                   |                    |                    | (13.29) (I)   |                     |
| <b>Voltage Discount, Summer On Peak and Winter Weekdays (4-9pm) Demand - \$/kW</b> |                  |               |                   |                  |                   |                    |                    |               |                     |
| From 2 kV to 50 kV   | 0.00             | (0.13) (I)    |                   |                  |                   |                    |                    | (0.13) (I)    | (0.18) (I)          |
| Above 50 kV but below 220 kV   | 0.00             | (3.93) (I)    |                   |                  |                   |                    |                    | (3.93) (I)    | (0.47) (I)          |
| At 220 kV  | 0.00             | (9.31) (I)    |                   |                  |                   |                    |                    | (9.31) (I)    | (0.47) (I)          |
| <b>Voltage Discount, Energy - \$/kWh</b>   |                  |               |                   |                  |                   |                    |                    |               |                     |
| From 2 kV to 50 kV   | 0.00000          | (0.00013) (I) |                   |                  |                   |                    |                    | (0.00013) (I) | (0.00104) (I)       |
| Above 50 kV but below 220 kV   | 0.00000          | (0.00364) (I) |                   |                  |                   |                    |                    | (0.00364) (I) | (0.00229) (I)       |
| At 220 kV  | 0.00000          | (0.00870) (I) |                   |                  |                   |                    |                    | (0.00870) (I) | (0.00290) (I)       |
| <b>Power Factor Adjustment - \$/kVAR</b>   |                  |               |                   |                  |                   |                    |                    |               |                     |
| Greater than 50 kV   |                  | 0.54          |                   |                  |                   |                    |                    | 0.54          |                     |
| 50 kV or less  |                  | 0.80          |                   |                  |                   |                    |                    |               |                     |
| <b>California Alternate Rates for Energy Discount - %</b>                          |                  |               |                   |                  |                   |                    |                    |               |                     |
|  |                  | 100.00*       |                   |                  |                   |                    |                    | 100.00*       |                     |
| <b>Option D-CPP</b>  |                  |               |                   |                  |                   |                    |                    |               |                     |
| <b>CPP Event Energy Charge - \$/kWh</b>  |                  |               |                   |                  |                   |                    |                    |               |                     |
| Summer CPP Non-Event Credit  |                  |               |                   |                  |                   |                    |                    | 0.80000       |                     |
| On-Peak Demand Credit - \$/kW  |                  |               |                   |                  |                   |                    |                    | (7.55)        |                     |
| <b>Maximum Available Credit - \$/kW**</b>  |                  |               |                   |                  |                   |                    |                    |               |                     |
| Summer Weekdays (4-9pm)  |                  |               |                   |                  |                   |                    |                    | (22.36) (I)   |                     |

- \* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.  
 \*\* The ongoing Competition Transition Charge (CTC) of \$(0.00015) 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 Trans = Transmission and the Transmission Owners Tariff Charge Adjustments (TOTCA) which are FERC approved. The TOTCA represents the Transmission Revenue Balancing Account Adjustment (TRBAA) of \$(0.00141) per kWh, Reliability Services Balancing Account Adjustment (RSBAA) of \$(0.00079) per kWh, and Transmission Access Charge Balancing Account Adjustment (TACBAA) of \$0.00315 per kWh.  
 2 Distribn = Distribution  
 3 NSGC = New System Generation Charge  
 4 NDC = Nuclear Decommissioning Charge  
 5 PPPC = Public Purpose Programs Charge (Including California Alternate Rates for Energy Surcharge where applicable.)  
 6 DWRBC = Department of Water Resources (DWR) Bond Charge. The DWR Bond Charge is the Wildfire Fund Non-Bypassable Charge which supports the California Wildfire Fund and is not applicable to exempt Customers pursuant to D.19-10-056.  
 7 PUCRF = The PUC Reimbursement Fee is described in Schedule RF-E.  
 8 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.  
 9 Generation = The Generation rates are applicable only to Bundled Service Customers. See Special Condition below for PCA recovery.  
 10 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.

(Continued)

(To be inserted by utility)

Advice 4719-E  
Decision \_\_\_\_\_

307

Issued by  
Michael Backstrom  
Vice President

(To be inserted by Cal. PUC)

Date Submitted Feb 15, 2022  
Effective Mar 1, 2022  
Resolution \_\_\_\_\_

## 8.2.3 SCG

Figure 12. SCG Gas Schedule – G-10

|  |                    |   |
|--|--------------------|---|
| <b>SOUTHERN CALIFORNIA GAS COMPANY</b><br>LOS ANGELES, CALIFORNIA    CANCELING | Revised<br>Revised | CAL. P.U.C. SHEET NO. 46445-G<br>CAL. P.U.C. SHEET NO. 46215-G<br>43002-G |
|--|--------------------|---|

|  |         |
|--|---------|
| Schedule No. G-10  | Sheet 1 |
| <b><u>CORE COMMERCIAL AND INDUSTRIAL SERVICE</u></b><br><b><u>(Includes GN-10, GN-10C and GT-10 Rates)</u></b> |         |

**APPLICABILITY**

Applicable to core non-residential natural gas service, including both procurement service (GN rates) and transportation-only service (GT rates) including Core Aggregation Transportation (CAT). This schedule is also available to residential customers with separately metered service to common facilities (swimming pools, recreation rooms, saunas, spas, etc.) only and otherwise eligible for service under rates designated for GM-C, GM-CC, GM-BC, GM-BCC, GT-MC or GT-MBC, as appropriate, if so elected by the customer. Also applicable to service not provided under any other rate schedule. Pursuant to D.02-08-065, this schedule is not available to those electric generation, refinery, and enhanced oil recovery customers that are defined as ineligible for core service in Rule No. 23.B.

The California Alternate Rates for Energy (CARE) discount of 20%, reflected as a separate line item on the bill, is applicable to Nonprofit Group Living Facilities and Qualified Agricultural Employee Housing Facilities (migrant farmworker housing centers, privately owned employee housing, and agricultural employee housing operated by nonprofit entities) that meet the requirements for the CARE as set forth in Schedule No. G-CARE.

**TERRITORY**

Applicable throughout the service territory.

**RATES**

**Customer Charge**

Per meter, per day:

|                                  |           |
|----------------------------------|-----------|
| All customers except             |           |
| "Space Heating Only"             | 49.315¢   |
| "Space Heating Only" customers:  |           |
| Beginning Dec. 1 through Mar. 31 | \$1.48760 |
| Beginning Apr. 1 through Nov. 30 | None      |

(Continued)

|  |  |  |
|--|--|--|
| (TO BE INSERTED BY UTILITY)<br>ADVICE LETTER NO. 4152<br>DECISION NO. 98-07-068<br><small>1011</small> | ISSUED BY<br><b>Lee Schavrien</b><br>Senior Vice President<br>Regulatory Affairs | (TO BE INSERTED BY CAL. PUC)<br>DATE FILED <u>Sep 30, 2010</u><br>EFFECTIVE <u>Oct 1, 2010</u><br>RESOLUTION NO. _____ |
|--|--|--|

**SOUTHERN CALIFORNIA GAS COMPANY** Revised CAL P.U.C. SHEET NO. 60204-G  
LOS ANGELES, CALIFORNIA CANCELING Revised CAL P.U.C. SHEET NO. 60169-G

Schedule No. G-10  
**CORE COMMERCIAL AND INDUSTRIAL SERVICE**  
(Includes GN-10, GN-10C and GT-10 Rates)  
(Continued)

Sheet 2

**RATES** (Continued)

All Procurement, Transmission, and Commodity Charges are billed per therm.

|                              |   | <u>Tier I<sup>1/</sup></u> | <u>Tier II<sup>1/</sup></u> | <u>Tier III<sup>1/</sup></u> |       |
|------------------------------|---|----------------------------|-----------------------------|------------------------------|-------|
| <b>GN-10:</b> <sup>4/</sup>  | Applicable to natural gas procurement service to non-residential core customers, including service not provided under any other rate schedule.  |                            |                             |                              |       |
| Procurement Charge:          | G-CPNR .....  | 64.959¢                    | 64.959¢                     | 64.959¢                      | R,R,R |
| Transmission Charge:         | GPT-10 .....  | 106.047¢                   | 60.635¢                     | 30.186¢                      |       |
| Commodity Charge:            | GN-10 .....   | 171.006¢                   | 125.594¢                    | 95.145¢                      | R,R,R |
| <b>GN-10C:</b> <sup>4/</sup> | Core procurement service for previous non-residential transportation-only customers returning to core procurement service, including CAT customers with annual consumption over 50,000 therms, as further defined in Schedule No. G-CP. |                            |                             |                              |       |
| Procurement Charge:          | G-CPNRC .....   | 72.898¢                    | 72.898¢                     | 72.898¢                      |       |
| Transmission Charge:         | GPT-10 .....  | 106.047¢                   | 60.635¢                     | 30.186¢                      |       |
| Commodity Charge:            | GN-10C .....  | 178.945¢                   | 133.533¢                    | 103.084¢                     |       |
| <b>GT-10:</b> <sup>4/</sup>  | Applicable to non-residential transportation-only service including CAT service, as set forth in Special Condition 13.  |                            |                             |                              |       |
| Transmission Charge:         | GT-10 .....   | 106.047¢ <sup>3/</sup>     | 60.635¢ <sup>3/</sup>       | 30.186¢ <sup>3/</sup>        |       |

<sup>1/</sup> Tier I rates are applicable for the first 250 therms used per month. Tier II rates are applicable for usage above Tier I quantities and up through 4,167 therms per month. Tier III rates are applicable for all usage above 4,167 therms per month. Under this schedule, the winter season shall be defined as December 1 through March 31 and the summer season as April 1 through November 30.

<sup>2/</sup> This charge is applicable for service to Utility Procurement Customers as shown in Schedule No. G-CP, in the manner approved by D.96-08-037, and subject to change monthly, as set forth in Special Condition 5.

<sup>3/</sup> These charges are equal to the core commodity rate less the following two components as approved in D.97-04-082: (1) the weighted average cost of gas; and (2) the core brokerage fee.

(Footnotes continue next page.)

(Continued)

(TO BE INSERTED BY UTILITY)  
ADVICE LETTER NO. 6051  
DECISION NO. 98-07-068


ISSUED BY  
**Dan Skopec**  
Senior Vice President  
Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)  
SUBMITTED Oct 31, 2022  
EFFECTIVE Nov 1, 2022  
RESOLUTION NO. \_\_\_\_\_

208

## 8.2.4 SDG&E

Figure 13. SDG&E Electric Schedule – AL-TOU



San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 35374-E  
Canceling Revised Cal. P.U.C. Sheet No. 31333-E

Sheet 2

**SCHEDULE AL-TOU**  
**GENERAL SERVICE - TIME METERED**

RATES\*

| Description – AL-TOU        | Transm | Distr     | PPP | ND | CTC | LGC | RS | TRAC | UDC Total   |
|-----------------------------|--------|-----------|-----|----|-----|-----|----|------|-------------|
| <u>Basic Service Fees</u>   |        |           |     |    |     |     |    |      |             |
| (\$/month)                  |        |           |     |    |     |     |    |      |             |
| <u>0-500 kW</u>             |        |           |     |    |     |     |    |      |             |
| Secondary                   |        | 199.35    | I   |    |     |     |    |      | 199.35 I    |
| Primary                     |        | 53.75     | I   |    |     |     |    |      | 53.75 I     |
| Secondary Substation        |        | 18,717.35 | I   |    |     |     |    |      | 18,717.35 I |
| Primary Substation          |        | 18,717.35 | I   |    |     |     |    |      | 18,717.35 I |
| Transmission                |        | 289.91    | I   |    |     |     |    |      | 289.91 I    |
| <u>&gt; 500 kW</u>          |        |           |     |    |     |     |    |      |             |
| Secondary                   |        | 766.91    | I   |    |     |     |    |      | 766.91 I    |
| Primary                     |        | 63.95     | I   |    |     |     |    |      | 63.95 I     |
| Secondary Substation        |        | 18,717.35 | I   |    |     |     |    |      | 18,717.35 I |
| Primary Substation          |        | 18,717.35 | I   |    |     |     |    |      | 18,717.35 I |
| Transmission                |        | 1,159.95  | I   |    |     |     |    |      | 1,159.95 I  |
| <u>&gt; 12 MW</u>           |        |           |     |    |     |     |    |      |             |
| Secondary Substation        |        | 31,585.50 | I   |    |     |     |    |      | 31,585.50 I |
| Primary Substation          |        | 31,644.17 | I   |    |     |     |    |      | 31,644.17 I |
| <u>Trans. Multiple Bus</u>  |        | 3,000.00  |     |    |     |     |    |      | 3,000.00    |
| <u>Distance Adjust. Fee</u> |        |           |     |    |     |     |    |      |             |
| Secondary - OH              |        | 1.23      |     |    |     |     |    |      | 1.23        |
| Secondary - UG              |        | 3.17      |     |    |     |     |    |      | 3.17        |
| Primary - OH                |        | 1.22      |     |    |     |     |    |      | 1.22        |
| Primary - UG                |        | 3.13      |     |    |     |     |    |      | 3.13        |

(Continued)

2C7

Advice Ltr. No. 3855-E

Decision No. 21-07-010

Issued by  
**Dan Skopec**  
Vice President  
Regulatory Affairs

Submitted Sep 30, 2021

Effective Nov 1, 2021

Resolution No. \_\_\_\_\_



San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 36350-E

Canceling Revised Cal. P.U.C. Sheet No. 35768-E

**SCHEDULE AL-TOU**  
**GENERAL SERVICE - TIME METERED**

Sheet 3

**RATES\* (Continued)**

| Description – AL-TOU          | Transm | Distr | PPP | ND   | CTC  | LGC | RS   | TRAC | UDC<br>Total |
|-------------------------------|--------|-------|-----|------|------|-----|------|------|--------------|
| <b>Demand Charges (\$/kW)</b> |        |       |     |      |      |     |      |      |              |
| <u>Non-Coincident</u>         |        |       |     |      |      |     |      |      |              |
| Secondary                     | 18.63  | 12.69 | I   |      | 0.00 |     | 0.00 |      | 31.32 I      |
| Primary                       | 18.00  | 12.62 | I   |      | 0.00 |     | 0.00 |      | 30.62 I      |
| Secondary Substation          | 18.63  | 0.23  | I   | 0.52 | 0.37 | I   | 0.00 |      | 19.75 I      |
| Primary Substation            | 18.00  | 0.23  | I   | 0.52 | 0.37 | I   | 0.00 |      | 19.12 I      |
| Transmission                  | 17.93  | 0.23  | I   | 0.52 | 0.37 | I   | 0.00 |      | 19.05 I      |
| <u>Maximum On-Peak</u>        |        |       |     |      |      |     |      |      |              |
| <u>Summer</u>                 |        |       |     |      |      |     |      |      |              |
| Secondary                     | 3.90   | 23.90 | I   |      |      |     |      |      | 27.80 I      |
| Primary                       | 3.77   | 23.77 | I   |      |      |     |      |      | 27.54 I      |
| Secondary Substation          | 3.90   | 0.00  |     |      |      |     |      |      | 3.90         |
| Primary Substation            | 3.77   | 0.00  |     |      |      |     |      |      | 3.77         |
| Transmission                  | 3.75   | 0.00  |     |      |      |     |      |      | 3.75         |
| <u>Winter</u>                 |        |       |     |      |      |     |      |      |              |
| Secondary                     | 0.82   | 27.92 | I   |      |      |     |      |      | 28.74 I      |
| Primary                       | 0.79   | 27.77 | I   |      |      |     |      |      | 28.56 I      |
| Secondary Substation          | 0.82   | 0.00  |     |      |      |     |      |      | 0.82         |
| Primary Substation            | 0.79   | 0.00  |     |      |      |     |      |      | 0.79         |
| Transmission                  | 0.79   | 0.00  |     |      |      |     |      |      | 0.79         |
| <u>Power Factor (\$/kvar)</u> |        |       |     |      |      |     |      |      |              |
| Secondary                     |        | 0.25  |     |      |      |     |      |      | 0.25         |
| Primary                       |        | 0.25  |     |      |      |     |      |      | 0.25         |
| Secondary Substation          |        | 0.25  |     |      |      |     |      |      | 0.25         |
| Primary Substation            |        | 0.25  |     |      |      |     |      |      | 0.25         |
| Transmission                  |        | 0.00  |     |      |      |     |      |      | 0.00         |

(Continued)

3C9  
Advice Ltr. No. 4004-E  
Decision No. 22-03-003

Issued by  
**Dan Skopec**  
Vice President  
Regulatory Affairs

Submitted May 16, 2022  
Effective Jun 1, 2022  
Resolution No.



San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 36351-E

Canceling Revised Cal. P.U.C. Sheet No. 35769-E

**SCHEDULE AL-TOU**  
**GENERAL SERVICE - TIME METERED**

Sheet 4

**RATES\* (Continued)**

| Description - AL-TOU           | Transm    | Distr   | PPP       | ND      | CTC     | LGC       | RS        | TRAC | UDC Total |
|--------------------------------|-----------|---------|-----------|---------|---------|-----------|-----------|------|-----------|
| <b>Energy Charges (\$/kWh)</b> |           |         |           |         |         |           |           |      |           |
| <b>On-Peak - Summer</b>        |           |         |           |         |         |           |           |      |           |
| Secondary                      | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Primary                        | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Secondary Substation           | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Primary Substation             | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Transmission                   | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| <b>Off-Peak - Summer</b>       |           |         |           |         |         |           |           |      |           |
| Secondary                      | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Primary                        | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Secondary Substation           | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Primary Substation             | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Transmission                   | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| <b>Super Off-Peak</b>          |           |         |           |         |         |           |           |      |           |
| Secondary                      | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Primary                        | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Secondary Substation           | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Primary Substation             | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Transmission                   | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| <b>On-Peak - Winter</b>        |           |         |           |         |         |           |           |      |           |
| Secondary                      | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Primary                        | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Secondary Substation           | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Primary Substation             | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Transmission                   | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| <b>Off-Peak - Winter</b>       |           |         |           |         |         |           |           |      |           |
| Secondary                      | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Primary                        | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Secondary Substation           | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Primary Substation             | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Transmission                   | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| <b>Super Off-Peak</b>          |           |         |           |         |         |           |           |      |           |
| Secondary                      | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Primary                        | (0.01745) | 0.00132 | I 0.01979 | 0.00007 | 0.00106 | I 0.00289 | I 0.00001 |      | 0.00769 I |
| Secondary Substation           | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Primary Substation             | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |
| Transmission                   | (0.01745) | 0.00068 | I 0.01837 | 0.00007 |         | 0.00289   | I 0.00001 |      | 0.00457 I |

**Notes:** Transmission Energy charges include the Transmission Revenue Balancing Account Adjustment (TRBAA) of \$(0.00130) per kWh and the Transmission Access Charge Balancing Account Adjustment (TACBAA) of \$(0.01615) per kWh. The PPP rate is composed of Energy and Demand charges. For all voltage levels, the PPP Energy charges includes Low Income PPP rate (LI-PPP) \$0.01080/kWh, Non-low Income PPP rate (Non-LI-PPP) \$0.00300/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 \$0.00477/kWh. For Secondary and Primary voltage levels, the PPP Energy charge also includes California Solar Initiative rate (CSI) of \$0.00000/kWh and Self-Generation Incentive Program rate (SGIP) \$ 0.00142 /kWh. For Secondary Substation, Primary Substation and Transmission voltage levels, the PPP rate includes Demand charges for CSI of \$0.00 /kW and SGIP of \$0.52 /kW.

\*These rates are not applicable to TOU Period Grandfathering Eligible Customer Generators, please refer to SC 20 for applicable rates.


(Continued)

4C8  
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Decision No. 22-03-003

Issued by  
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Regulatory Affairs

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Figure 14. SDG&E Electric Schedule - EECC



San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 36409-E

Cancelling Revised Cal. P.U.C. Sheet No. 35858-E

**SCHEDULE EECC**

ELECTRIC ENERGY COMMODITY COST

Sheet 5

Commodity Rates (Continued)

| <u>Schedule A-TC</u> | <u>(\$/kWh)</u> |   |
|----------------------|-----------------|---|
| Summer               | 0.08147         | R |
| Winter               | 0.08147         | R |

Schedule TOU-M

|                       |         |   |
|-----------------------|---------|---|
| <u>Summer</u>         |         |   |
| On-Peak Energy        | 0.34164 | R |
| Off-Peak Energy       | 0.11656 | R |
| Super Off-Peak Energy | 0.06544 | R |
| <u>Winter</u>         |         |   |
| On-Peak Energy        | 0.13581 | R |
| Off-Peak Energy       | 0.07640 | R |
| Super Off-Peak Energy | 0.05903 | R |

Schedule OL-TOU

|                       |         |   |
|-----------------------|---------|---|
| <u>Summer</u>         |         |   |
| On-Peak Energy        | 0.40931 | R |
| Off-Peak Energy       | 0.13921 | R |
| Super Off-Peak Energy | 0.07661 | R |
| <u>Winter</u>         |         |   |
| On-Peak Energy        | 0.16089 | R |
| Off-Peak Energy       | 0.09017 | R |
| Super Off-Peak Energy | 0.06966 | R |

Schedule AL-TOU

|                                       | <u>(\$/kW)</u> |   |
|---------------------------------------|----------------|---|
| <u>Maximum On-Peak Demand: Summer</u> |                |   |
| Secondary                             | 12.18          | R |
| Primary                               | 12.12          | R |
| Secondary Substation                  | 12.18          | R |
| Primary Substation                    | 12.12          | R |
| Transmission                          | 11.60          | R |
| <u>Maximum On-Peak Demand: Winter</u> |                |   |
| Secondary                             |                |   |
| Primary                               |                |   |
| Secondary Substation                  |                |   |
| Primary Substation                    |                |   |
| Transmission                          |                |   |
| <u>On-Peak Energy: Summer</u>         |                |   |
| Secondary                             | 0.17868        | R |
| Primary                               | 0.17782        | R |
| Secondary Substation                  | 0.17868        | R |
| Primary Substation                    | 0.17782        | R |
| Transmission                          | 0.17021        | R |
| <u>Off-Peak Energy: Summer</u>        |                |   |
| Secondary                             | 0.10423        | R |
| Primary                               | 0.10375        | R |
| Secondary Substation                  | 0.10423        | R |
| Primary Substation                    | 0.10375        | R |
| Transmission                          | 0.09933        | R |
| <u>Super Off-Peak Energy: Summer</u>  |                |   |
| Secondary                             | 0.09960        | R |
| Primary                               | 0.09927        | R |
| Secondary Substation                  | 0.09960        | R |
| Primary Substation                    | 0.09927        | R |
| Transmission                          | 0.09526        | R |

(Continued)

5C8

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**Dan Skopec**

Vice President


Regulatory Affairs

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Figure 15. SDG&E Gas Schedule – GN-3



San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 18445-G  
Canceling Revised Cal. P.U.C. Sheet No. 18058-G

**SCHEDULE GN-3** Sheet 1

NATURAL GAS SERVICE FOR CORE NON-RESIDENTIAL CUSTOMERS  
(Includes Rates for GN-3, GN-3C, GN-3/GTC and GN-3/GTCA)

**APPLICABILITY**

Applicable to core nonresidential natural gas service, including both procurement service and transportation-only service including Core Aggregation Transportation (CAT). Also applicable to service not provided under any other rate schedule. This schedule is not available to electric generation customers who generator's rated capacity exceeds one megawatt, refinery customers, and enhanced oil recovery customers, whose gas consumption exceeds 250,000 therms per year.

The GN-3 rate is applicable to natural gas procurement and transportation service to nonresidential core customers and to separately metered, common area use service to residential detached homes. This schedule is optionally available to customers with separately metered, common area use service to residential, multi-family accommodations, as defined in Rule 1.

The GN-3C cross-over rate is a core procurement service for previous transportation-only customers returning to core procurement service customers with annual consumption over 50,000 therms, as set forth in Special Condition 8.

The GN-3/GTC (GTC) and GN-3/GTCA (GTCA) rates are applicable to intrastate gas transportation-only services as set forth in Special Conditions 9-14.

Non-profit group living facilities taking service under this schedule may be eligible for a 20% low-income rate discount on their bill, if such facilities qualify to receive service under the terms and conditions of Schedule G-CARE.

Agricultural Employee Housing Facilities, as defined in Schedule G-CARE, may qualify for a 20% CARE discount on the bill if all eligibility criteria set forth in Form 142-4032 or Form 142-4035 is met.

**TERRITORY**

Within the entire territory served natural gas by the Utility.

| <u>RATES</u>                                      | <u>GN-3</u> | <u>GN-3-C</u> | <u>GTC/GTCA</u> |
|---|-------------|---------------|-----------------|
| <u>Customer charges</u> , \$ per meter per month: | \$10.00     | \$10.00       | \$10.00         |

(Continued)

1C11

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**Lee Schavrien**  
Senior Vice President  
Regulatory Affairs

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Resolution No. \_\_\_\_\_

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San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 26223-G

Canceling Revised Cal. P.U.C. Sheet No. 26210-G

### SCHEDULE GN-3

Sheet 2

#### NATURAL GAS SERVICE FOR CORE NON-RESIDENTIAL CUSTOMERS (Includes Rates for GN-3, GN-3C, GN-3/GTC and GN-3/GTCA)

#### RATES (continued)

##### Volumetric charges, \$ per therm:

|                                      | GN-3      | GN-3C       | GTC/GTCA <sup>2</sup> |
|--------------------------------------|-----------|-------------|-----------------------|
| Procurement Charge (0 to 1,000)      | \$0.65036 | \$0.71790 R | N/A                   |
| Transportation Charge                | \$0.72856 | \$0.72856   | \$0.72858             |
| Total Charge                         | \$1.37892 | \$1.44646 R | \$0.72858             |
| Procurement Charge (1,001 to 21,000) | \$0.65036 | \$0.71790 R | N/A                   |
| Transportation Charge                | \$0.48510 | \$0.48510   | \$0.48512             |
| Total Charge                         | \$1.13546 | \$1.20300 R | \$0.48512             |
| Procurement Charge (Over 21,000)     | \$0.65036 | \$0.71790 R | N/A                   |
| Transportation Charge                | \$0.41632 | \$0.41632   | \$0.41634             |
| Total Charge                         | \$1.06668 | \$1.13422 R | \$0.41634             |

<sup>2</sup> The rates for core transportation-only customers, with the exception of customers taking service under Schedule GT-NGV, include any FERC Settlement Proceeds Memorandum Account (FSPMA) credit adjustments.

#### Standby Service Fee for GTC/GTCA Customers

Per decatherm \$10

This fee shall be assessed to customers only during curtailments of transportation services to firm noncore customers. This fee will apply only to the difference between the customer's nominations and their confirmed deliveries.

The customer's storage volumes, if available, may be used to offset the standby service fee. Revenues collected from this fee shall be credited to the Utility's Non-Margin Fixed Cost Account (NMFCA). Curtailments of standby services provided to core customers are described in Rule 14.

GTC/GTCA customers who receive service under this schedule shall also be eligible for standby services ahead of such services offered to noncore customers, including core subscription customers.

Billing adjustments may be necessary to reflect changes in volumes used in developing prior periods' transportation charges.

(Continued)

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Senior Vice President  
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## 8.2.5 CPAU

Figure 16. CPAU Electric Schedule – E-2

### RESIDENTIAL MASTER-METERED AND SMALL NON-RESIDENTIAL ELECTRIC SERVICE

#### UTILITY RATE SCHEDULE E-2

#### A. APPLICABILITY:

This Rate Schedule applies to the following Customers receiving Electric Service from the City of Palo Alto Utilities:

1. Small non-residential Customers receiving Non-Demand Metered Electric Service; and
2. Customers with Accounts at Master-Metered multi-family facilities.

#### B. TERRITORY:

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

#### C. UNBUNDLED RATES:

| <u>Per kilowatt-hour (kWh)</u> | <u>Commodity</u> | <u>Distribution</u> | <u>Public Benefits</u> | <u>Total</u> |
|--------------------------------|------------------|---------------------|------------------------|--------------|
| Summer Period                  | \$0.12151        | \$0.09276           | \$0.00469              | \$0.21896    |
| Winter Period                  | 0.08715          | 0.06171             | 0.00469                | 0.15355      |
| <u>Minimum Bill (\$/day)</u>   |                  |                     |                        | 0.8777       |

#### 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. Seasonal Rate Changes

The Summer Period is effective May 1 to October 31 and the Winter Period is effective from November 1 to April 30. When the billing period includes use in both the Summer and the Winter Periods, the usage will be prorated based on the number of days in each seasonal period, and the charges based on the applicable rates therein. For further discussion of bill calculation and proration, refer to Rule and Regulation 11.

**CITY OF PALO ALTO UTILITIES**  
Issued by the City Council

*Supersedes Sheet No E-2-1  
dated 7-1-2019*



**CITY OF  
PALO ALTO  
UTILITIES**

Sheet No E-2-1  
Effective 7-1-2022

Figure 17. CPAU Gas Schedule – G-2



### Monthly Gas Commodity & Volumetric Rates

Your gas bill includes two charge types: 1) a service charge, and 2) a volumetric charge. The service charge for your gas service can be found on the appropriate rate schedule, which you can find in the following locations: [Residential Rate Schedules](#), and [Business Rate Schedules](#).

The volumetric charge depends on your consumption, and the rate varies monthly based on the current price of gas. The following tables show the volumetric rates (\$/Therm) for each gas rate schedule. The volumetric rates include a) a Commodity charge, which represents the cost of the gas, b) a Distribution rate, c) a Cap and Trade Compliance charge, a d) Carbon Offset Charge and e) a Transportation Charge. The Cap and Trade charge covers the cost of acquiring compliance instruments in California's Cap and Trade program, and will change in response to market conditions, sales volumes, and the quantity of allowances required. The Transportation Charge is based on the current PG&E G-WSL rate for Palo Alto, accounting for delivery losses to the Customer's Meter. Prior to November 1, 2016, it was included within the Distribution rate.

On September 15, 2014, Council adopted Resolution #9451 authorizing the City's participation in a natural gas purchase from Municipal Gas Acquisition and Supply Corporation (MuniGas) for the City's entire retail gas load for a period of at least 10 years. The MuniGas transaction includes a mechanism for municipal utilities to utilize their tax-exempt status to achieve a discount on the market price of gas. As of November 1, 2018, gas will begin flowing under this program, reducing the City's gas commodity cost by about \$1 Million per year and saving gas customers approximately \$0.03 per Therm on the commodity portion of their bills.

These charges are shown on the left-hand side of the table below for information purposes, while the total volumetric rate (Commodity+ Distribution+ Cap and Trade Compliance+ Carbon Offset+ Transportation) is shown on the right-hand side of the table. To calculate your variable gas costs, apply the total rate to your consumption for each month. If you are a resident, note that your gas rate varies based on how much you consume (Tier 1 and Tier 2). For information on consumption tiers please refer to the [G-1 Residential Gas Service Rate Schedule](#).

If you have questions on your bill, please call the City of Palo Alto Utilities Customer Service Center at 650-329-2161.

| Effective Date | Commodity Rate | Cap and Trade Compliance Charge | Transportation Charge | Carbon Offset Charge | Total Volumetric Rate |           |  |                        |
|----------------|----------------|---------------------------------|-----------------------|----------------------|-----------------------|-----------|--|------------------------|
|                |                |                                 |                       |                      | G-1 (Residential)     |           | G-2 (Master Metered Multi-Family and Small Commercial) | G-3 (Large Commercial) |
|                |                |                                 |                       |                      | Tier 1                | Tier 2    |  |                        |
|                | per Therm      | per Therm                       | per Therm             | per Therm            | per Therm             | per Therm | per Therm  | per Therm              |
| 3/1/22         | 0.5370         | 0.0486                          | 0.15000               | 0.040                | 1.30460               | 2.12820   | 1.47040  | 1.46350                |
| 2/1/22         | 0.5360         | 0.0486                          | 0.15000               | 0.040                | 1.30360               | 2.12720   | 1.46940  | 1.46250                |
| 1/1/22         | 0.7714         | 0.0486                          | 0.15000               | 0.040                | 1.53900               | 2.36260   | 1.70480  | 1.69790                |
| 12/1/21        | 0.6321         | 0.0486                          | 0.12274               | 0.040                | 1.37244               | 2.19604   | 1.53824  | 1.53134                |
| 11/1/21        | 0.7505         | 0.0486                          | 0.12274               | 0.040                | 1.49084               | 2.31444   | 1.65664  | 1.64974                |
| 10/1/21        | 0.7175         | 0.0486                          | 0.12274               | 0.040                | 1.45784               | 2.28144   | 1.62364  | 1.61674                |
| 9/1/21         | 0.5217         | 0.0486                          | 0.12274               | 0.040                | 1.26204               | 2.08564   | 1.42784  | 1.42094                |
| 8/1/21         | 0.5492         | 0.0486                          | 0.12274               | 0.040                | 1.28954               | 2.11314   | 1.45534  | 1.44844                |
| 7/1/21         | 0.4800         | 0.0486                          | 0.12274               | 0.040                | 1.22034               | 2.04394   | 1.38614  | 1.37924                |
| 6/1/21         | 0.3982         | 0.0486                          | 0.12214               | 0.040                | 1.11274               | 1.89714   | 1.27064  | 1.26404                |
| 5/1/21         | 0.3901         | 0.0486                          | 0.12200               | 0.040                | 1.10450               | 1.88890   | 1.26240  | 1.25580                |
| 4/1/21         | 0.3375         | 0.0486                          | 0.12200               | 0.040                | 1.05190               | 1.83630   | 1.20980  | 1.20320                |
| 3/1/21         | 0.3577         | 0.0486                          | 0.12200               | 0.040                | 1.07210               | 1.85650   | 1.23000  | 1.22340                |

## 8.2.6 SMUD (Electric Only)

Figure 18. SMUD Electric Schedule – CITS-0/CITS-1

### Commercial & Industrial Time-of-Day Rate Schedule CI-TOD1

#### C. Restructured Commercial & Industrial Time-of-Day Rates

|  | Effective as of<br>October 1, 2021 | Effective as of<br>March 1, 2022 | Effective as of<br>January 1, 2023 |
|--|------------------------------------|----------------------------------|------------------------------------|
| <b>CITS-0: C&amp;I Secondary 0-20 kW</b>                             |                                    |                                  |                                    |
| <b>Non-Summer Season (October - May)</b>                             |                                    |                                  |                                    |
| System Infrastructure Fixed Charge per month per meter               | \$28.40                            | \$28.85                          | \$35.15                            |
| Maximum Demand Charge \$ per monthly max kW                          | \$0.000                            | \$0.000                          | \$0.000                            |
| Electricity Usage Charge   |                                    |                                  |                                    |
| Peak \$/kWh  | \$0.1430                           | \$0.1451                         | \$0.1440                           |
| Off-Peak \$/kWh  | \$0.1393                           | \$0.1414                         | \$0.1364                           |
| Off-Peak Savar \$/kWh  | \$0.1373                           | \$0.1394                         | \$0.1323                           |
| <b>Summer Season (June - September)</b>                              |                                    |                                  |                                    |
| System Infrastructure Fixed Charge per month per meter               | \$28.40                            | \$28.85                          | \$35.15                            |
| Maximum Demand Charge \$ per monthly max kW                          | \$0.000                            | \$0.000                          | \$0.000                            |
| Electricity Usage Charge   |                                    |                                  |                                    |
| Peak \$/kWh  | \$0.2355                           | \$0.2390                         | \$0.2554                           |
| Off-Peak \$/kWh  | \$0.1331                           | \$0.1351                         | \$0.1349                           |
| <b>CITS-1: C&amp;I Secondary 21-299 kW</b>                           |                                    |                                  |                                    |
| <b>Non-Summer Season (October - May)</b>                             |                                    |                                  |                                    |
| System Infrastructure Fixed Charge per month per meter               | \$88.05                            | \$89.35                          | \$158.30                           |
| Site Infrastructure Charge per 12 months max kW or contract capacity | \$7.930                            | \$8.049                          | \$7.568                            |
| Electricity Usage Charge   |                                    |                                  |                                    |
| Peak \$/kWh  | \$0.1169                           | \$0.1187                         | \$0.1230                           |
| Off-Peak \$/kWh  | \$0.1136                           | \$0.1153                         | \$0.1158                           |
| Off-Peak Savar \$/kWh  | \$0.1078                           | \$0.1094                         | \$0.1030                           |
| <b>Summer Season (June - September)</b>                              |                                    |                                  |                                    |
| System Infrastructure Fixed Charge per month per meter               | \$88.05                            | \$89.35                          | \$158.30                           |
| Site Infrastructure Charge per 12 months max kW or contract capacity | \$7.930                            | \$8.049                          | \$7.568                            |
| Summer Peak Demand Charge \$ per monthly Peak max kW                 | \$1.680                            | \$1.705                          | \$3.468                            |
| Electricity Usage Charge   |                                    |                                  |                                    |
| Peak \$/kWh  | \$0.1897                           | \$0.1925                         | \$0.1983                           |
| Off-Peak \$/kWh  | \$0.1102                           | \$0.1119                         | \$0.1119                           |

New restructured commercial rates beyond 2023 are effective as shown in Section IX. Transition Schedule.

#### IV. Electricity Usage Surcharges

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

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

#### V. Rate Option Menu

- A. Energy Assistance Program for Nonprofit Agencies. Refer to Rate Schedule EAPR.
- B. Campus Rates. Refer to Rate Schedule CB.
- C. Implementation of Energy Efficiency Program or Installation of New Solar/Photovoltaic or Storage Systems

Customers who implement a SMUD-sponsored Energy Efficiency program or who install a SMUD-approved solar/photovoltaic or storage system to offset their on-site energy usage may request, in writing, within 30 days of the project completion and commissioning, an adjustment to their twelve month maximum demand based on the anticipated reduction in kW from the Energy Efficiency Project Worksheet. The adjusted twelve month maximum demand is valid for 12 months or until it is exceeded by actual maximum demand.

## 8.2.7 Escalation Rates

Utility rates are assumed to escalate over time, using assumptions from research conducted by Energy and Environmental Economics (E3) in Appendix 8.2. The 2019 *study Residential Building Electrification in California* (Energy + Environmental Economics 2019a) and escalation rates used in the development of the 2022 TDV multipliers

Table 24 below demonstrate the escalation rates used for nonresidential buildings. As stated by E3 in the TDV report, this latter assumption “does not presuppose specific new investments, changes in load and gas throughput, or other measures associated with complying with California’s climate policy goals” (i.e., business-as-usual is assumed).

**Table 24. Real Utility Rate Escalation Rate Assumptions Above Inflation**

|      | Source   | Statewide Electric Nonresidential Average Rate (%/year, real) | Statewide Natural Gas Nonresidential Core Rate (%/year, real) |
|------|----------|---|---|
| 2023 | E3 2019  | 2.0%  | 4.0%  |
| 2024 | 2022 TDV | 0.7%  | 7.7%  |
| 2025 | 2022 TDV | 0.5%  | 5.5%  |
| 2026 | 2022 TDV | 0.7%  | 5.6%  |
| 2027 | 2022 TDV | 0.2%  | 5.6%  |
| 2028 | 2022 TDV | 0.6%  | 5.7%  |
| 2029 | 2022 TDV | 0.7%  | 5.7%  |
| 2030 | 2022 TDV | 0.6%  | 5.8%  |
| 2031 | 2022 TDV | 0.6%  | 3.3%  |
| 2032 | 2022 TDV | 0.6%  | 3.6%  |
| 2033 | 2022 TDV | 0.6%  | 3.4%  |
| 2034 | 2022 TDV | 0.6%  | 3.4%  |
| 2035 | 2022 TDV | 0.6%  | 3.2%  |
| 2036 | 2022 TDV | 0.6%  | 3.2%  |
| 2037 | 2022 TDV | 0.6%  | 3.1%  |

## 8.3 HVAC and SHW System Cost Scalers

Table 25 shows the material and labor adjustment factors used to determine the costs.

**Table 25. Materials and Labor Adjustment Factors by Climate Zone**

|       | Materials | Labor |
|-------|-----------|-------|
| CZ 01 | 0.963     | 0.994 |
| CZ 02 | 0.963     | 1.387 |
| CZ 03 | 1.001     | 1.291 |
| CZ 04 | 0.998     | 1.298 |
| CZ 05 | 0.964     | 0.997 |
| CZ 06 | 0.960     | 0.997 |
| CZ 07 | 0.999     | 0.985 |
| CZ 08 | 0.998     | 0.996 |
| CZ 09 | 0.964     | 0.996 |
| CZ 10 | 0.998     | 0.996 |
| CZ 11 | 1.002     | 0.990 |
| CZ 12 | 1.000     | 1.000 |

|              |       |       |
|--------------|-------|-------|
| <b>CZ 13</b> | 1.000 | 0.990 |
| <b>CZ 14</b> | 0.964 | 0.980 |
| <b>CZ 15</b> | 0.963 | 0.996 |
| <b>CZ 16</b> | 0.967 | 0.990 |

Table 26 shows the contractor markup values used to determine the costs.

**Table 26. Contractor Markup Values**

|  | Contractor 1 | Contractor 2 |
|--|--------------|--------------|
| <b>General Conditions and Overhead</b> | 15%          | 20%          |
| <b>Design and Engineering</b>          | 5%           | 10%          |
| <b>Permit, testing and inspection</b>  | 5%           | 3%           |
| <b>Contractor Profit/Market Factor</b> | 10%          | 10%          |

## 8.4 Mixed Fuel Baseline Figures

**Table 27. Mixed Fuel Baseline Model – Medium Office**

| Climate zone | Utility | Annual Electricity Consumption (kWh) | Annual Natural Gas Consumption (therms) | Total kTDV/ft2 | Total TDV Compliance kTDV/ft2 | Efficiency TDV Compliance kTDV/ft2 | GHG Emissions tons/yr | Total TDV Compliance Margin | Proposed Elec Utility Cost | Proposed Gas Utility Cost |
|--------------|---------|--------------------------------------|---|----------------|-------------------------------|------------------------------------|-----------------------|-----------------------------|----------------------------|---------------------------|
| CZ01         | PG&E    | 186,894                              | 5,331                                   | 130            | 10                            | 72                                 | 63                    | 1                           | \$67,234                   | \$10,377                  |
| CZ02         | PG&E    | 163,979                              | 3,253                                   | 142            | 12                            | 107                                | 52                    | 2                           | \$67,798                   | \$6,493                   |
| CZ03         | PG&E    | 176,640                              | 2,672                                   | 131            | 5                             | 83                                 | 48                    | 1                           | \$67,999                   | \$5,352                   |
| CZ04         | PG&E    | 163,768                              | 2,003                                   | 125            | -2                            | 107                                | 46                    | 1                           | \$68,366                   | \$4,093                   |
| CZ04-2       | CPAU    | 163,768                              | 2,003                                   | 125            | -2                            | 107                                | 46                    | 1                           | \$30,988                   | \$6,966                   |
| CZ05         | PG&E    | 170,544                              | 2,575                                   | 113            | -8                            | 76                                 | 46                    | 1                           | \$66,040                   | \$5,156                   |
| CZ05-2       | SCG     | 170,544                              | 2,575                                   | 113            | -8                            | 76                                 | 46                    | 1                           | \$66,040                   | \$4,242                   |
| CZ06         | SCE     | 163,722                              | 1,066                                   | 122            | -7                            | 76                                 | 39                    | 0                           | \$76,817                   | \$1,980                   |
| CZ07         | SDG&E   | 169,611                              | 747                                     | 114            | -9                            | 76                                 | 38                    | 0                           | \$120,127                  | \$1,150                   |
| CZ08         | SCE     | 191,703                              | 941                                     | 130            | -2                            | 76                                 | 41                    | 1                           | \$83,752                   | \$1,763                   |
| CZ09         | SCE     | 169,514                              | 1,119                                   | 135            | 0                             | 76                                 | 41                    | 1                           | \$82,274                   | \$2,046                   |
| CZ10         | SDG&E   | 185,682                              | 1,445                                   | 141            | 10                            | 76                                 | 45                    | 2                           | \$134,646                  | \$2,113                   |
| CZ10-2       | SCE     | 185,682                              | 1,445                                   | 141            | 10                            | 76                                 | 45                    | 2                           | \$86,338                   | \$2,474                   |
| CZ11         | PG&E    | 209,343                              | 3,309                                   | 166            | 40                            | 136                                | 59                    | 2                           | \$81,001                   | \$6,669                   |
| CZ12         | PG&E    | 178,461                              | 2,864                                   | 145            | 19                            | 118                                | 53                    | 2                           | \$72,381                   | \$5,784                   |
| CZ12-2       | SMUD    | 178,461                              | 2,864                                   | 145            | 19                            | 118                                | 53                    | 2                           | \$26,576                   | \$5,784                   |
| CZ13         | PG&E    | 211,193                              | 2,377                                   | 165            | 37                            | 139                                | 55                    | 2                           | \$81,491                   | \$4,852                   |
| CZ14         | SDG&E   | 156,689                              | 3,058                                   | 147            | 13                            | 139                                | 52                    | 3                           | \$128,390                  | \$4,337                   |
| CZ14-2       | SCE     | 156,689                              | 3,058                                   | 147            | 13                            | 139                                | 52                    | 3                           | \$83,690                   | \$4,756                   |
| CZ15         | SCE     | 209,720                              | 662                                     | 161            | 32                            | 139                                | 47                    | 2                           | \$101,041                  | \$1,311                   |
| CZ16         | PG&E    | 177,562                              | 5,799                                   | 127            | 9                             | 94                                 | 67                    | 4                           | \$68,281                   | \$11,409                  |

**Table 28. All-electric Baseline Model – Medium Retail**

| Climate zone | Utility | Annual Electricity Consumption (kWh) | Annual Natural Gas Consumption (therms) | Total kTDV/ft2 | Total TDV Compliance kTDV/ft2 | Efficiency TDV Compliance kTDV/ft2 | GHG Emissions tons/yr | Total TDV Compliance Margin | Proposed Elec Utility Cost | Proposed Gas Utility Cost |
|--------------|---------|--------------------------------------|---|----------------|-------------------------------|------------------------------------|-----------------------|-----------------------------|----------------------------|---------------------------|
| CZ01         | PG&E    | 138,367                              | 0                                       | 192            | 110                           | 162                                | 28                    | -8                          | \$43,917                   | \$0                       |
| CZ02         | PG&E    | 131,521                              | 0                                       | 211            | 125                           | 198                                | 28                    | -15                         | \$50,499                   | \$0                       |
| CZ03         | PG&E    | 112,237                              | 0                                       | 176            | 91                            | 156                                | 25                    | -1                          | \$36,206                   | \$0                       |
| CZ04         | PG&E    | 122,256                              | 0                                       | 197            | 111                           | 193                                | 27                    | -5                          | \$47,522                   | \$0                       |
| CZ04-2       | CPAU    | 122,256                              | 0                                       | 197            | 111                           | 193                                | 27                    | -5                          | \$22,961                   | \$0                       |
| CZ05         | PG&E    | 108,753                              | 0                                       | 159            | 76                            | 146                                | 24                    | -8                          | \$35,179                   | \$0                       |
| CZ05-2       | SCG     | 108,753                              | 0                                       | 159            | 76                            | 146                                | 24                    | -8                          | \$35,179                   | \$0                       |
| CZ06         | SCE     | 111,442                              | 0                                       | 175            | 89                            | 146                                | 24                    | -8                          | \$42,572                   | \$0                       |
| CZ07         | SDG&E   | 109,079                              | 0                                       | 172            | 87                            | 146                                | 23                    | 0                           | \$71,108                   | \$0                       |
| CZ08         | SCE     | 129,105                              | 0                                       | 196            | 107                           | 146                                | 26                    | -10                         | \$47,404                   | \$0                       |
| CZ09         | SCE     | 123,673                              | 0                                       | 193            | 105                           | 146                                | 26                    | -3                          | \$46,830                   | \$0                       |
| CZ10         | SDG&E   | 114,235                              | 0                                       | 174            | 87                            | 146                                | 25                    | 4                           | \$77,903                   | \$0                       |
| CZ10-2       | SCE     | 114,235                              | 0                                       | 174            | 87                            | 146                                | 25                    | 4                           | \$45,763                   | \$0                       |
| CZ11         | PG&E    | 144,411                              | 0                                       | 229            | 144                           | 218                                | 30                    | -6                          | \$54,592                   | \$0                       |
| CZ12         | PG&E    | 141,639                              | 0                                       | 221            | 136                           | 211                                | 30                    | -4                          | \$53,798                   | \$0                       |
| CZ12-2       | SMUD    | 141,639                              | 0                                       | 221            | 136                           | 211                                | 30                    | -4                          | \$21,079                   | \$0                       |
| CZ13         | PG&E    | 153,371                              | 0                                       | 244            | 158                           | 236                                | 32                    | -15                         | \$56,701                   | \$0                       |
| CZ14         | SDG&E   | 145,499                              | 0                                       | 223            | 135                           | 236                                | 31                    | -8                          | \$86,177                   | \$0                       |
| CZ14-2       | SCE     | 145,499                              | 0                                       | 223            | 135                           | 236                                | 31                    | -8                          | \$52,840                   | \$0                       |
| CZ15         | SCE     | 146,092                              | 0                                       | 244            | 158                           | 236                                | 29                    | -24                         | \$56,750                   | \$0                       |
| CZ16         | PG&E    | 157,944                              | 0                                       | 224            | 144                           | 214                                | 34                    | -31                         | \$57,190                   | \$0                       |

**Table 29. Mixed Fuel Baseline Model – Quick-Service Restaurant**

| Climate zone | Utility | Annual Electricity Consumption (kWh) | Annual Natural Gas Consumption (therms) | Total kTDV/ft2 | Total TDV Compliance kTDV/ft2 | Efficiency TDV Compliance kTDV/ft2 | GHG Emissions tons/yr | Total TDV Compliance Margin | Proposed Elec Utility Cost | Proposed Gas Utility Cost |
|--------------|---------|--------------------------------------|---|----------------|-------------------------------|------------------------------------|-----------------------|-----------------------------|----------------------------|---------------------------|
| CZ01         | PG&E    | 63,187                               | 12,237                                  | 1,974          | 820                           | 820                                | 80                    | 5                           | \$20,126                   | \$23,401                  |
| CZ02         | PG&E    | 66,343                               | 11,170                                  | 1,989          | 839                           | 839                                | 74                    | 20                          | \$21,332                   | \$21,422                  |
| CZ03         | PG&E    | 67,877                               | 10,605                                  | 1,922          | 769                           | 769                                | 71                    | 1                           | \$21,657                   | \$20,336                  |
| CZ04         | PG&E    | 77,615                               | 10,277                                  | 2,062          | 910                           | 910                                | 71                    | -4                          | \$24,931                   | \$19,725                  |
| CZ04-2       | CPAU    | 77,615                               | 10,277                                  | 2,062          | 910                           | 910                                | 71                    | -4                          | \$15,041                   | \$30,442                  |
| CZ05         | PG&E    | 69,442                               | 10,655                                  | 1,898          | 744                           | 744                                | 71                    | -2                          | \$22,105                   | \$20,416                  |
| CZ05-2       | SCG     | 69,442                               | 10,655                                  | 1,898          | 744                           | 744                                | 71                    | -2                          | \$22,105                   | \$14,924                  |
| CZ06         | SCE     | 78,813                               | 9,600                                   | 1,934          | 778                           | 744                                | 67                    | -1                          | \$19,698                   | \$13,599                  |
| CZ07         | SDG&E   | 76,653                               | 9,425                                   | 1,898          | 739                           | 744                                | 66                    | 18                          | \$26,903                   | \$13,116                  |
| CZ08         | SCE     | 77,418                               | 9,554                                   | 1,948          | 792                           | 744                                | 66                    | 28                          | \$20,356                   | \$13,542                  |
| CZ09         | SCE     | 77,625                               | 9,687                                   | 1,993          | 837                           | 744                                | 67                    | 7                           | \$20,405                   | \$13,709                  |
| CZ10         | SDG&E   | 81,897                               | 9,907                                   | 2,032          | 877                           | 744                                | 69                    | 26                          | \$31,166                   | \$13,782                  |
| CZ10-2       | SCE     | 81,897                               | 9,907                                   | 2,032          | 877                           | 744                                | 69                    | 26                          | \$21,407                   | \$13,986                  |
| CZ11         | PG&E    | 85,725                               | 10,748                                  | 2,259          | 1,109                         | 1,109                              | 75                    | -12                         | \$27,885                   | \$20,664                  |
| CZ12         | PG&E    | 74,131                               | 10,726                                  | 2,080          | 928                           | 928                                | 72                    | 2                           | \$24,000                   | \$20,605                  |
| CZ12-2       | SMUD    | 74,131                               | 10,726                                  | 2,080          | 928                           | 928                                | 72                    | 2                           | \$11,272                   | \$20,605                  |
| CZ13         | PG&E    | 88,060                               | 10,441                                  | 2,240          | 1,089                         | 1,089                              | 73                    | -2                          | \$28,620                   | \$20,070                  |
| CZ14         | SDG&E   | 87,498                               | 10,655                                  | 2,251          | 1,097                         | 1,089                              | 74                    | -31                         | \$30,692                   | \$14,728                  |
| CZ14-2       | SCE     | 87,498                               | 10,655                                  | 2,251          | 1,097                         | 1,089                              | 74                    | -31                         | \$22,471                   | \$14,925                  |
| CZ15         | SCE     | 118,353                              | 9,194                                   | 2,444          | 1,289                         | 1,089                              | 71                    | -13                         | \$28,746                   | \$13,090                  |
| CZ16         | PG&E    | 75,373                               | 12,242                                  | 2,143          | 983                           | 983                                | 82                    | 2                           | \$24,194                   | \$23,494                  |

**Table 30. Mixed Fuel Baseline Model – Small Hotel**

| Climate zone | Utility | Annual Electricity Consumption (kWh) | Annual Natural Gas Consumption (therms) | Total kTDV/ft2 | Total TDV Compliance kTDV/ft2 | Efficiency TDV Compliance kTDV/ft2 | GHG Emissions tons/yr | Total TDV Compliance Margin | Proposed Elec Utility Cost | Proposed Gas Utility Cost |
|--------------|---------|--------------------------------------|---|----------------|-------------------------------|------------------------------------|-----------------------|-----------------------------|----------------------------|---------------------------|
| CZ01         | PG&E    | 230,187                              | 16,824                                  | 299            | 161                           | 173                                | 137                   | 7                           | \$72,520                   | \$32,208                  |
| CZ02         | PG&E    | 243,164                              | 13,161                                  | 287            | 152                           | 169                                | 117                   | 5                           | \$77,188                   | \$25,351                  |
| CZ03         | PG&E    | 232,511                              | 12,725                                  | 272            | 136                           | 151                                | 113                   | 6                           | \$73,496                   | \$24,461                  |
| CZ04         | PG&E    | 251,386                              | 11,608                                  | 280            | 146                           | 165                                | 109                   | 5                           | \$80,034                   | \$22,342                  |
| CZ04-2       | CPAU    | 251,386                              | 11,608                                  | 280            | 146                           | 165                                | 109                   | 5                           | \$48,175                   | \$34,218                  |
| CZ05         | PG&E    | 232,585                              | 12,375                                  | 264            | 127                           | 143                                | 111                   | 6                           | \$73,479                   | \$23,746                  |
| CZ05-2       | SCG     | 232,585                              | 12,375                                  | 264            | 127                           | 143                                | 111                   | 6                           | \$73,479                   | \$17,084                  |
| CZ06         | SCE     | 251,627                              | 10,100                                  | 260            | 124                           | 143                                | 100                   | 4                           | \$53,976                   | \$14,227                  |
| CZ07         | SDG&E   | 250,625                              | 9,977                                   | 257            | 120                           | 143                                | 100                   | 3                           | \$77,312                   | \$13,878                  |
| CZ08         | SCE     | 271,204                              | 9,874                                   | 269            | 136                           | 143                                | 101                   | 3                           | \$60,488                   | \$13,943                  |
| CZ09         | SCE     | 265,607                              | 10,246                                  | 273            | 140                           | 143                                | 103                   | 4                           | \$60,896                   | \$14,411                  |
| CZ10         | SDG&E   | 276,218                              | 9,903                                   | 276            | 142                           | 143                                | 102                   | 3                           | \$91,917                   | \$13,642                  |
| CZ10-2       | SCE     | 276,218                              | 9,903                                   | 276            | 142                           | 143                                | 102                   | 3                           | \$63,534                   | \$13,980                  |
| CZ11         | PG&E    | 285,482                              | 12,457                                  | 315            | 179                           | 197                                | 118                   | 4                           | \$82,170                   | \$24,172                  |
| CZ12         | PG&E    | 263,561                              | 11,890                                  | 293            | 158                           | 176                                | 112                   | 2                           | \$76,104                   | \$23,029                  |
| CZ12-2       | SMUD    | 263,561                              | 11,890                                  | 293            | 158                           | 176                                | 112                   | 2                           | \$34,853                   | \$23,029                  |
| CZ13         | PG&E    | 293,124                              | 11,309                                  | 310            | 175                           | 193                                | 113                   | 1                           | \$84,632                   | \$21,924                  |
| CZ14         | SDG&E   | 276,292                              | 12,071                                  | 298            | 166                           | 193                                | 115                   | 2                           | \$89,492                   | \$16,232                  |
| CZ14-2       | SCE     | 276,292                              | 12,071                                  | 298            | 166                           | 193                                | 115                   | 2                           | \$63,611                   | \$16,703                  |
| CZ15         | SCE     | 349,319                              | 7,895                                   | 309            | 174                           | 193                                | 98                    | -4                          | \$78,507                   | \$11,458                  |
| CZ16         | PG&E    | 228,611                              | 17,363                                  | 310            | 170                           | 195                                | 142                   | 9                           | \$72,664                   | \$33,471                  |

## 8.5 GHG Savings Summary

This section shows the percent GHG savings for each package. GHG multipliers in CBECC software have utility emissions multipliers assigned only to each of the California's sixteen climate zones, does not vary by utility within each zone. Individual utility assumptions may vary widely. In the Medium Office, the GHG emissions increases in all-electric package because the proposed all-electric system is electric resistance VAV system instead of a more efficient heat pump boiler system.

Figure 19. Percentage GHG Savings – Medium Office

| CZ   | Mixed Fuel | All-electric |     |         |
|------|------------|--------------|-----|---------|
|      | EE         | Code Min     | EE  | EE + LF |
| cz01 | 0%         | 3%           | 4%  | 12%     |
| cz02 | 1%         | 0%           | 1%  | 8%      |
| cz03 | 1%         | 0%           | 1%  | 8%      |
| cz04 | 2%         | -1%          | 1%  | 7%      |
| cz05 | 1%         | 0%           | 2%  | 9%      |
| cz06 | 2%         | 0%           | 2%  | 8%      |
| cz07 | 3%         | 0%           | 3%  | 8%      |
| cz08 | 3%         | 0%           | 2%  | 8%      |
| cz09 | 2%         | -1%          | 2%  | 7%      |
| cz10 | 2%         | -2%          | 0%  | 6%      |
| cz11 | 1%         | -3%          | -1% | 5%      |
| cz12 | 1%         | -2%          | -1% | 5%      |
| cz13 | 2%         | -3%          | -1% | 4%      |
| cz14 | 2%         | -4%          | -2% | 5%      |
| cz15 | 3%         | -1%          | 2%  | 7%      |
| cz16 | 1%         | 1%           | 2%  | 7%      |

Figure 20. Percentage GHG Savings – Medium Retail

| CZ   | Mixed Fuel |          | All-electric |
|------|------------|----------|--------------|
|      | EE         | Code Min | EE           |
| cz01 | -4%        | -2%      | 9%           |
| cz02 | -21%       | -13%     | 10%          |
| cz03 | -18%       | -8%      | 11%          |
| cz04 | -14%       | -5%      | 10%          |
| cz05 | -15%       | -5%      | 12%          |
| cz06 | -7%        | 4%       | 13%          |
| cz07 | -5%        | 7%       | 14%          |
| cz08 | -7%        | 4%       | 12%          |
| cz09 | -8%        | 3%       | 13%          |
| cz10 | -12%       | -9%      | 3%           |
| cz11 | -23%       | -21%     | 2%           |
| cz12 | -19%       | -11%     | 9%           |
| cz13 | -17%       | -8%      | 10%          |
| cz14 | -15%       | -5%      | 10%          |
| cz15 | -3%        | 0%       | 3%           |
| cz16 | -34%       | -33%     | 2%           |

Figure 21. Percentage GHG Savings – Quick Service Restaurant

| CZ   | Mixed Fuel | All-electric "HS" (HVAC+SHW) |     |         |         | All-electric |     |
|------|------------|------------------------------|-----|---------|---------|--------------|-----|
|      | EE         | Code Min                     | EE  | EE + LF | EE + PV | Code Min     | EE  |
| cz01 | 10%        | 21%                          | 26% | 28%     | 27%     | 47%          | 52% |
| cz02 | 7%         | 16%                          | 19% | 21%     | 21%     | 45%          | 49% |
| cz03 | 8%         | 14%                          | 20% | 22%     | 22%     | 45%          | 51% |
| cz04 | 7%         | 12%                          | 17% | 19%     | 19%     | 43%          | 49% |
| cz05 | 8%         | 14%                          | 20% | 22%     | 22%     | 45%          | 51% |
| cz06 | 7%         | 9%                           | 15% | 16%     | 17%     | 43%          | 48% |
| cz07 | 6%         | 8%                           | 14% | 15%     | 16%     | 43%          | 48% |
| cz08 | 4%         | 9%                           | 12% | 13%     | 14%     | 43%          | 46% |
| cz09 | 5%         | 9%                           | 12% | 13%     | 15%     | 43%          | 46% |
| cz10 | 5%         | 10%                          | 13% | 14%     | 15%     | 42%          | 46% |
| cz11 | 6%         | 13%                          | 17% | 18%     | 18%     | 43%          | 46% |
| cz12 | 6%         | 14%                          | 17% | 18%     | 19%     | 44%          | 48% |
| cz13 | 6%         | 12%                          | 15% | 16%     | 17%     | 43%          | 46% |
| cz14 | 6%         | 13%                          | 16% | 17%     | 18%     | 42%          | 46% |
| cz15 | 4%         | 7%                           | 9%  | 11%     | 12%     | 40%          | 42% |
| cz16 | 8%         | 18%                          | 23% | 24%     | 24%     | 44%          | 49% |

Figure 22. Percentage GHG Savings – Small Hotel

| CZ   | Mixed Fuel | All-electric |     |         | All-electric    |
|------|------------|--------------|-----|---------|-----------------|
|      | EE         | Code Min     | EE  | EE + PV | Code Min (PTHP) |
| cz01 | 13%        | 47%          | 48% | 50%     | 47%             |
| cz02 | 11%        | 42%          | 44% | 47%     | 43%             |
| cz03 | 12%        | 43%          | 45% | 48%     | 43%             |
| cz04 | 11%        | 41%          | 44% | 46%     | 42%             |
| cz05 | 11%        | 43%          | 45% | 48%     | 43%             |
| cz06 | 10%        | 41%          | 43% | 46%     | 41%             |
| cz07 | 10%        | 41%          | 43% | 47%     | 41%             |
| cz08 | 10%        | 40%          | 42% | 46%     | 40%             |
| cz09 | 10%        | 40%          | 42% | 46%     | 40%             |
| cz10 | 11%        | 37%          | 39% | 43%     | 37%             |
| cz11 | 12%        | 39%          | 41% | 43%     | 39%             |
| cz12 | 12%        | 38%          | 41% | 43%     | 39%             |
| cz13 | 11%        | 37%          | 39% | 42%     | 37%             |
| cz14 | 12%        | 38%          | 40% | 44%     | 38%             |
| cz15 | 10%        | 33%          | 35% | 40%     | 33%             |
| cz16 | 13%        | 43%          | 46% | 48%     | 45%             |

## 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 Code Team stands ready to assist jurisdictions at any stage of a reach code project.



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Contact [info@localenergycodes.com](mailto:info@localenergycodes.com) for no-charge assistance from expert Reach Code advisors



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## Resources for Building Electrification Rebates & Incentives

### Individual Programs

*(Southern California Edison or Community Choice Aggregator Qualifying)*

- [Multifamily Energy Savings Program](#) – For properties receiving service from SCE or an affiliated CCA - no-cost and reduced-cost upgrades for lighting, heating and cooling, domestic hot water, building envelope and weatherization, appliances and plug loads, still exploring electrification opportunities
- [SOMAH by CPUC](#) – For installing solar photovoltaic (PV) energy systems on multifamily affordable housing
- [DAC-SASH Program](#) approved by CPUC – GRID provides incentives to cover the full cost of solar panels on customer homes and enables customers to save on their bills every month, qualify through [Energy For All Program](#)
- [Community Solar Green Tariff](#) by CPUC – provides local solar energy at a 20% bill discount for both income-qualified and non-income qualified residential customers in Disadvantaged Communities (DACs) who may be unable to install solar on their roof.
  - [Solar in DACs](#)
- [SCE Community Renewables Program](#) – allows SCE customers to work directly with developers to subscribe to a portion of a renewable energy project and receive bill credits from SCE based on their portion of the project's generation
- [SCE Building Electrification No Cost Program](#) - replacing natural gas and propane appliances with high-efficiency electric equipment for homeowners
- [Low Income Weatherization Program](#) - Farmworker Housing Component installs no-cost energy efficiency improvements and/or solar PV systems for qualified farmworker households. Multi-Family Energy Efficiency and Renewables Component provides technical assistance and incentives for the installation of energy efficiency measures and solar photovoltaic systems in low-income multi-family dwellings serving priority populations

*(PG&E Qualifying)*

- [PG&E Green Saver Program](#) – Provides eligible residential customers a 20% discount on electricity bills on top of any applicable CARE or FERA discounts for committing to 100% solar power
- [PG&E Energy Savings Assistance Program](#) – For renters and owners, can replace old refrigerator, furnace or water heater, perform insulation and weatherproofing, energy star LED lightbulbs – based on income guidelines and number of persons in household
- [Self-Generation Incentive Program](#) - financial rebate program for qualified PG&E residential and business customers installing battery storage systems. May cover full cost if residing in HFTD, experienced PSPS, etc. (residential and non-residential)

### Rebates/Incentives

- [Energy Star Instant Rebate](#) – \$90 rebate for Energy Star Certified room air conditioner
- [HEEHRA Multifamily Electric Load](#) Service Center – electric panel upgrades

- [HEEHRA Multifamily Appliance](#) Rebate – electric stove, cooktop, range or oven \*only for retrofits\*

#### Tax Credits

- [Energy-Efficient New Homes](#) Tax Credit for Home Builders - The federal Energy Policy Act of 2005 established tax credits of up to \$2,000 for builders of all new energy-efficient homes, including manufactured homes constructed in accordance with the Federal Manufactured Homes Construction and Safety Standards. Single Family homes and manufactured that are certified as a zero energy ready home under the Zero Energy Ready Home Program of the U.S. Department of Energy can receive a tax credit of \$5,000
- [Residential Energy Efficiency](#) Tax Credit - Owners of existing homes may receive a tax credit worth 30% of the cost of upgrading the efficiency of the building's envelope, includes things like exterior windows, insulation materials or systems designed to reduce heat loss or gain. Equipment must meet or exceed highest efficiency tier
- [Federal Residential Clean Energy](#) Credit – equals 30% of costs of new, qualified clean energy property for home battery storage
- [Federal Residential Clean Energy](#) Credit – equals 30% of costs of new, qualified clean energy property for home solar electric panels

#### Local Searches/Engines

[The Switch Is On](#)

[Database of State Incentives for Renewables & Efficiency](#)

*Other organizations with offerings:*

Central Coast Community Energy

CA Energy Smart Homes

## **ATTACHMENT 5**

### **CEQA Notice of Exemption**

## NOTICE OF EXEMPTION (NOE)

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**To:** ☐ Office of Planning and Research  
P.O. Box 3044, 1400 Tenth St. Rm. 212  
Sacramento, CA 95812-3044

☐ Clerk of the Board of Supervisors  
County of Santa Barbara  
105 E. Anapamu Street, Room 407  
Santa Barbara, CA 93101

**From:** City of Goleta  
130 Cremona Drive, Suite B  
Goleta, CA 93117



**Subject:** Filing of Notice of Exemption

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**Project Title:** Ordinance Amending Title 15, Chapter 15.03 of the Goleta Municipal Code for an Energy Performance Reach Code

**Project Applicant:** City of Goleta

**Project Location (Address and APN):** Goleta City Hall, 130 Cremona Drive, Suite B  
Goleta, CA 93117

**Description of Nature, Purpose and Beneficiaries of Project:** The purpose of the Energy Performance Reach Code is to modify the California Energy Code within the City of Goleta to require a higher level of energy performance with new construction. The ordinance encourages electrification and still allows for natural gas in buildings, although additional energy performance measures may be needed to comply. These additional measures may include increased energy efficiency (i.e. higher insulation), increased solar panel system size, and battery storage systems. For newly constructed buildings where fuel gas infrastructure is permitted due to any qualifying exceptions, they would be required to have sufficient electrical capacity, including reserved circuit breakers, electrical conduit, subpanels, panels, switchboards, and transformers, to facilitate future full building electrification. The ordinance would require higher energy performance for new single family, low-rise multifamily buildings and non-residential buildings, including pre-fabricated buildings; and provide for either reduced margins or exceptions for smaller homes and accessory dwelling units. The ordinance would extend electric readiness requirements through exterior location for space heat pump compressor in single family, space and ventilation requirements for in-unit water heaters in multifamily buildings, and electrical capacity requirements for multifamily central hot water systems, with an option to include space, ventilation, and condensate requirements.

Pursuant to California Health and Safety Code Sections 17958.5, 17958.7, and 18941.5, the local amendments to the 2022 Edition of the California Building and Energy Code are reasonably necessary due to local climactic, geological, or topographical conditions. The amendment is in the interests of public health and safety and general community welfare by contributing to the overall reduction of greenhouse gas (GHG) emissions and the reduction of air pollutants associated with new construction. Electric heat pumps for space and water heating are more efficient than their natural gas counterparts and have the added safety benefits of lowering the potential for carbon monoxide poisoning and gas explosions. New construction provides the best opportunity to avoid “lock-in emissions” which would be created through the inclusion of natural gas infrastructure in new buildings. The ordinance will help mitigate climate change and its negative effects such as extreme heat events, droughts, intense storms, and flooding in the region, thus making these amendments reasonably necessary because of local climactic, geological, and topographical reasons. The local amendments to the 2022 California Green Building

## NOTICE OF EXEMPTION (NOE)

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Standards Code implemented by this ordinance will reduce GHG emissions within the City with the intent to reduce the City's contributions to climate change and in turn reduce the impacts of climate change.

**Name of Public Agency Approving the Project:** City of Goleta

**Name of Person or Agency Carrying Out the Project:** City of Goleta

**Exempt Status:** *(check one)*

- ☐ Ministerial (Sec. 15369)
- ☐ Statutory (Sec. 21080.35)
- ☐ Categorical Exemption: (Sec. 15307 & 15308)
- ☐ Emergency Project (Sec. 15359)
- ☒ Other: (Sec 15061(b)(3))

**Reason(s) why the project is exempt:**

This ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. These standards are more stringent than the State energy standards, and as such, there are no reasonably foreseeable adverse impacts, and there is no possibility that the ordinance in question may have a significant effect on the environment. Adoption of the ordinance would not be an activity with potential to cause significant effect on the environment because the adoption and local amendments to the California Energy Code are enacted to provide more protection to the environment and therefore is exempt from CEQA. Therefore, it can be seen with certainty that there is no possibility that the ordinance in question may have a significant effect on the environment; accordingly, the ordinance is categorically exempt from CEQA.

**City of Goleta Contact Person and Telephone Number:**

Dana Murray, Sustainability Manager, 805-961-7547

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Peter Imhof

Director, Planning & Environmental Review

Date

## NOTICE OF EXEMPTION (NOE)

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**If filed by the applicant:**

1. Attach certified document of exemption finding
2. Has a Notice of Exemption been filed by the public agency approving the project?  
☐Yes ☐No

Date received for filing at OPR: \_\_\_\_\_

Note: Authority cited: Sections 21083 and 211110, Public Resources Code  
Reference: Sections 21108, 21152.1, Public Resources Code

## **ATTACHMENT 6**

### **Presentation**

# Energy Performance Reach Code

February 4, 2025

Presentation by:

Dana Murray, Sustainability Manager

Angeline Foshay, Management Analyst



# Background - Overview

- Reach Code modeled after similar codes adopted by other CA cities over the past 1 ½ years
- Collaboration with SB County & technical experts
- Energy Performance Reach Code would modify the CA Energy Code within Goleta to require a higher level of energy performance & electric-readiness for new construction
- Green Committee & Staff recommend adoption of an Energy Performance Reach Code



# Background

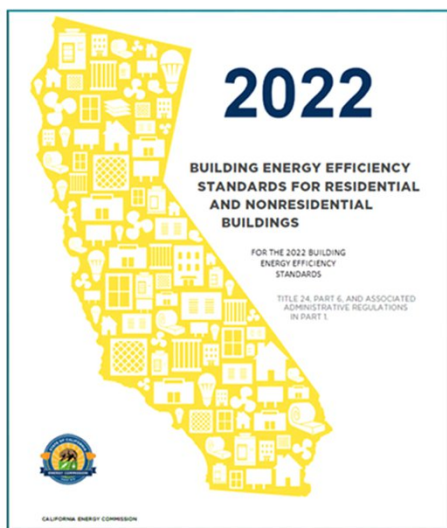
- State of California
  - All-electric buildings to be standard, likely in 2029
- City of Goleta
  - Goleta Strategic Plan
    - 1.1.3. Encourage renewable energy generation and use through installation of solar panels, battery energy storage, electric vehicle charging stations and similar measures
    - 1.1.4. Adopt a "Reach" Building Code
  - 2023 City Council – Building Electrification Ordinance (4/2023)
  - City Council 2024-2025 Annual Work Program (3/2024)
    - “New Construction Building Electrification: Evaluate Reach Code Options & Policy Development”
  - Green Committee recommends Energy Performance Reach Code (11/2024)



# Background - Reach Codes

- Local ordinances adopted by the local government that exceed and enhance the state's green building standards

## 2022 Energy Code



Other names:

- Title 24, Part 6
- Building Energy Efficiency Standards

Scope:

- Energy efficiency
- Load flexibility (PV, battery)
- Single Family, Multifamily, and Nonresidential

Pathways to amend:

- Mandatory
- Prescriptive
- Performance



# Background

- Natural gas use in buildings is large source of emissions & air pollution
- Limiting GHG emissions critical to avoid worsening climate change impacts
- New construction is opportunity for higher energy performance & electrification



# Background

## ➤ Electric buildings:

- Improve indoor air quality
- Improve safety & comfort
- Reduce greenhouse gas emissions
- Can be less expensive to construct



# Electrification Ordinance Litigation



| July 2019  | Nov 2019   | July 2021   | April 2023  | May 2023  | January 2024  |
|--|--|---|---|---|---|
| <p><b>The City of Berkeley adopts a municipal gas ban/all-electric Ordinance.</b></p> <p>The Ordinance prohibits, with some exceptions, natural gas infrastructure in newly constructed buildings.</p> | <p><b>The California Restaurant Association sued the City of Berkeley...</b></p> <p>...on the grounds that the Ordinance was preempted by the federal Energy Policy and Conservation Act (EPCA).</p> | <p><b>The District Court originally rejected the CRA challenge...</b></p> <p>...because the ordinance does not directly regulate either energy use or energy efficiency of covered appliances.</p> <p>The CRA appealed that decision.</p> | <p><b>The Ninth Circuit reversed the District Court decision, concluding that EPCA preempted Berkeley's ban...</b></p> <p>...because it prohibited the onsite installation of natural gas infrastructure necessary to support covered natural gas appliances.</p> | <p><b>The City of Berkeley filed a petition for an En Banc rehearing.</b></p> | <p><b>The Ninth Circuit denied an En Banc rehearing.</b></p> <p><b>Berkeley has decided to repealed their natural gas ban.</b></p> <p>Some jurisdictions are evaluating new building reach code approaches.</p> |

**Ruling Takeaway:** Natural gas appliances can't be directly prohibited from use based on the Energy Policy and Conservation Act (EPCA).

Source: [Climate Case Charts](#), Columbia Law [blog](#) and Earthjustice [blog](#); "Gloom Not Doom: The Latest in the Berkeley Decarbonization Case."



# Current Approaches

| Approach  | Description   | Advantages   | Challenges  | Who's done it?  |
|---|---|--|---|---|
| <b>Energy Performance</b>  | Requires a higher <i>Source Energy</i> compliance margin than what the state requires through the performance path of the Energy Code, Part 6.          | <ul style="list-style-type: none"> <li>Mitigates legal risk by allowing methane gas pathways</li> <li>Can provide an all-electric cost-effective pathway</li> <li>Enforcement process is already in place, the compliance margin is increased</li> </ul>   | <ul style="list-style-type: none"> <li>Limited to regulating space heating/cooling and water heating</li> <li>Likely lower carbon savings compared to all-electric only pathways</li> </ul>                                 | East Palo Alto<br>Encinitas<br>Palo Alto<br>Santa Cruz<br>San Jose<br>San Luis Obispo<br>Santa Monica |
| <b>Other Strategies</b>   |   |  |   |   |
| <b>Air Quality</b>        | Regulates building or appliance emissions through CALGreen, Part 11. Typically applies to areas that are in non-attainment for criteria air pollutants. | <ul style="list-style-type: none"> <li>Uses Clean Air Act authority rather than Energy Policy and Conservation Act</li> <li>Regulates all emitting equipment (cooking, fireplaces, dryers, etc.)</li> <li>Likely to result in all-electric construction, which includes construction cost savings</li> <li>Direct benefit to air quality / health</li> <li>High impact on emissions reduction</li> </ul> | <ul style="list-style-type: none"> <li>Legally untested</li> <li>Potentially new enforcement approach</li> <li>Concerns adopting this approach could negatively impact the on-going work with the AQMDs and CARB</li> </ul> | Los Altos Hills<br>New York City  |

# Requirements for Local Governments When Adopting Energy Reach Codes

1

Must use no more energy than the Energy Code

2

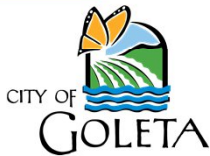
Energy efficiency/conservation measures **must be cost-effective**

3

Local governments must make findings that the reach code is needed for local climatic, geological, or topographical reasons and must file with the California Building Standards Commission (CBSC)

4

Can't require equipment that exceeds federal standards (federal preemption)



# Energy Performance Reach Code

- Requires buildings to meet energy budget/performance score
  - Custom design
  - Allows flexibility
  - Uses source energy as the performance metric
  - Good proxy for GHG emissions



# Energy Performance Reach Code

- Requires higher energy performance
  - For both all-electric & mixed-fuel buildings
  - Strong metric for encouraging electrification
  - Grid/emissions benefits in mixed fuel projects
- Does not prohibit or penalize gas technologies or preempt Federal regulations



# Energy Performance Reach Code

- Easy to implement
- Utilizes existing modeling software
  - Modeling software is free & provided by CA
  - Software updated with every State Code change
- Compliance demonstrated & enforced through Title 24 energy modeling reports for new buildings
  - Title 24 report already part of required permit submittals



# Cost-Effectiveness



- New construction all-electric buildings are cost-effective
  - Lower upfront cost of construction compared to mixed-fuel buildings
  - Value of benefits exceeds the cost
- Studies available at:
  - Local Energy Codes
  - State Cost-Effectiveness Explorer
- Must be approved by the CA Energy Commission



# Public Engagement

- Collaboration with County, Goleta, Carpinteria, City of SB
- 2022-2023 Building Electrification Ordinance
  - Hosted multiple public workshops & advisory group meetings
  - Presentations to South Coast Chamber of Commerce, Joint Affordable Housing Task Group, Santa Barbara Association of Realtors, Equity and Outreach Committee
- 2024-2025 Energy Performance Ordinance
  - Presentations to South Coast Chamber of Commerce, Santa Barbara Association of Realtors, Green Committee
  - January 14, 2025 Public Workshop



# Ordinance Overview

- Requires higher energy performance for new buildings
  - Reduced margins or exceptions for smaller homes and accessory dwelling units
  - Encourages building electrification while still allowing natural gas in buildings
    - Potential additional energy performance measures for mixed-fuel buildings
      - Energy efficiency (i.e., higher insulation)
      - Increased solar panel system size & battery storage systems
- Electric-Readiness Requirements
- Reach Code ordinance does not:
  - Prohibit or prevent gas technologies
  - Apply to additions and alterations
  - Apply to unregulated loads such as equipment and appliances for cooking, laundry, and pools



# Energy Performance Recommendations

| Building Type                  | Performance Requirement   |
|--------------------------------|---|
| Single-Family Residential      | EDR1 compliance margin of at least 5 points<br>Buildings <1,500 sq. ft. – EDR1 compliance margin of at least 2 points                               |
| Multi-Family Residential (Low) | Source Energy compliance margin of at least 7%  |
| Non-Residential                | Source Energy compliance margin of at least the following:<br>Hotel – 7%<br>Small Restaurants – 2%<br>Office – 14%<br>All Other Building Types – 7% |

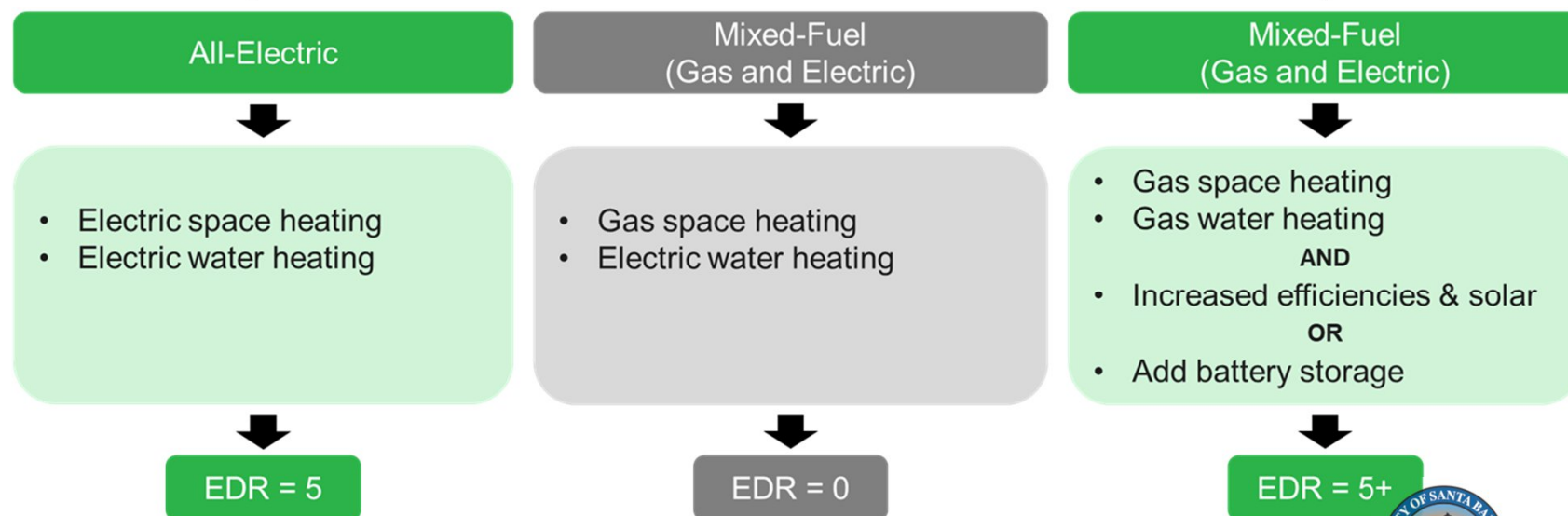
# Electric-Readiness Requirements

- Single Family projects using gas or propane furnace
  - 240-volt wiring within 3 feet of furnace
  - Reserved space in electrical service panel
  - Designated exterior space for future electric compressor unit
- Multifamily projects with individual gas water heaters
  - 125-volt receptacle within 3 feet of water heater
  - Designated space for future electric water heater



# How does it work?

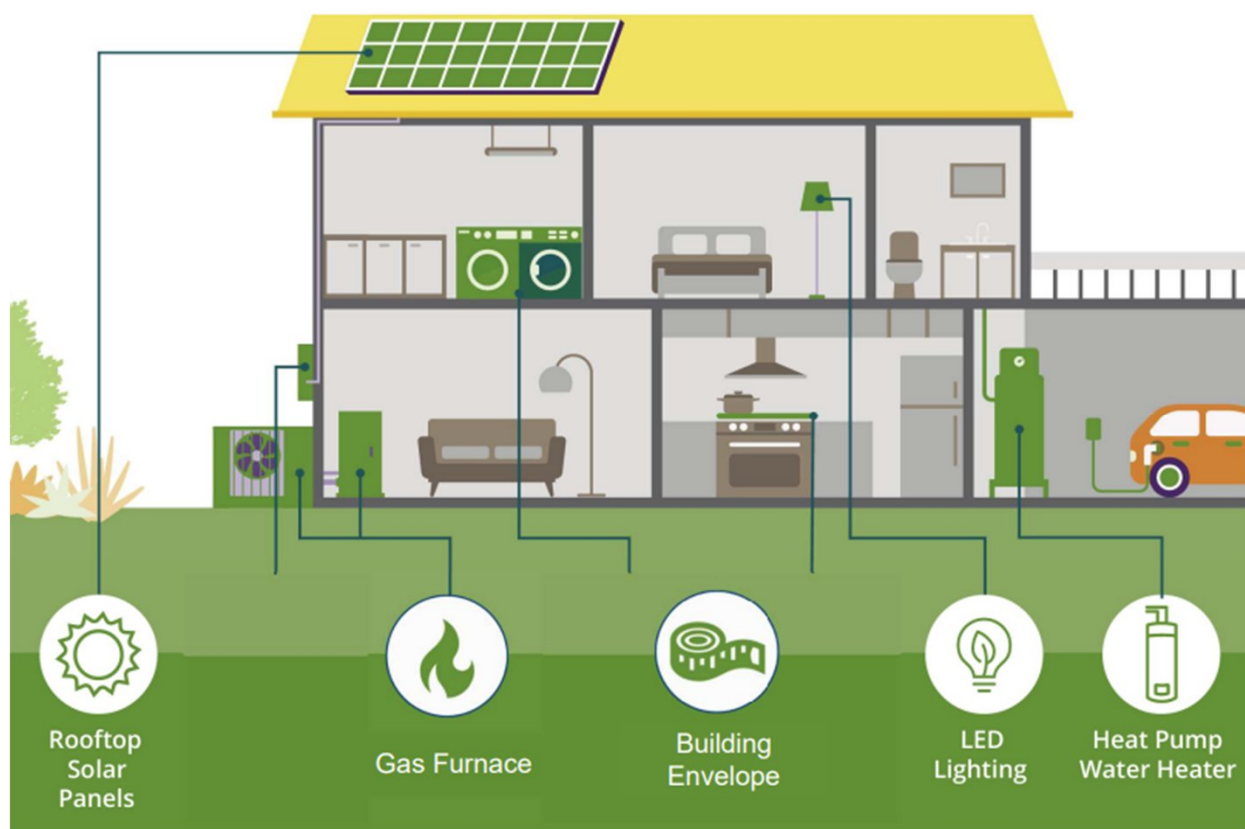
Title 24 reports generate compliance scores for new buildings to be constructed (EDR for single-family; Source Energy Margin for multifamily and nonresidential)



*Climate Zone 6, single family example displayed*



# Energy Performance Approach

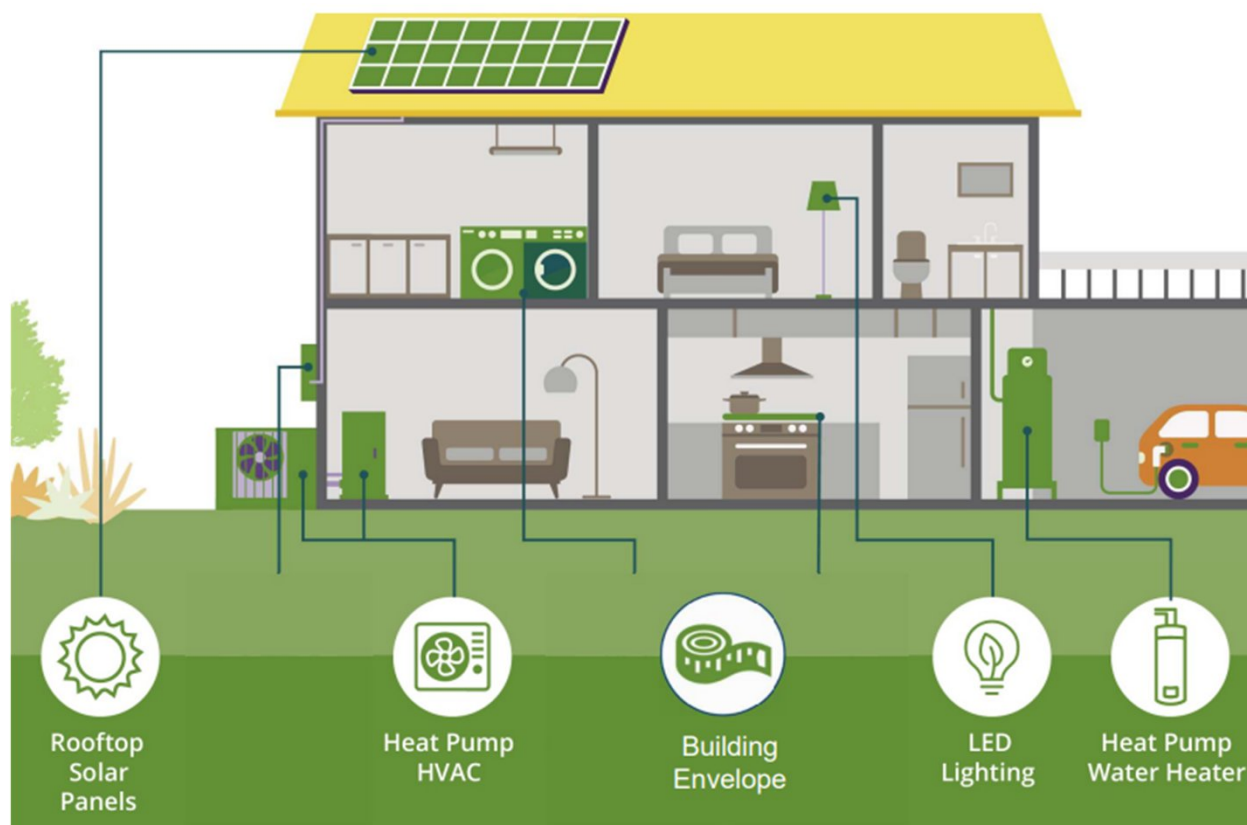


Standard  
Design  
Building

House Illustration source: Southern California Edison



# Energy Performance Approach



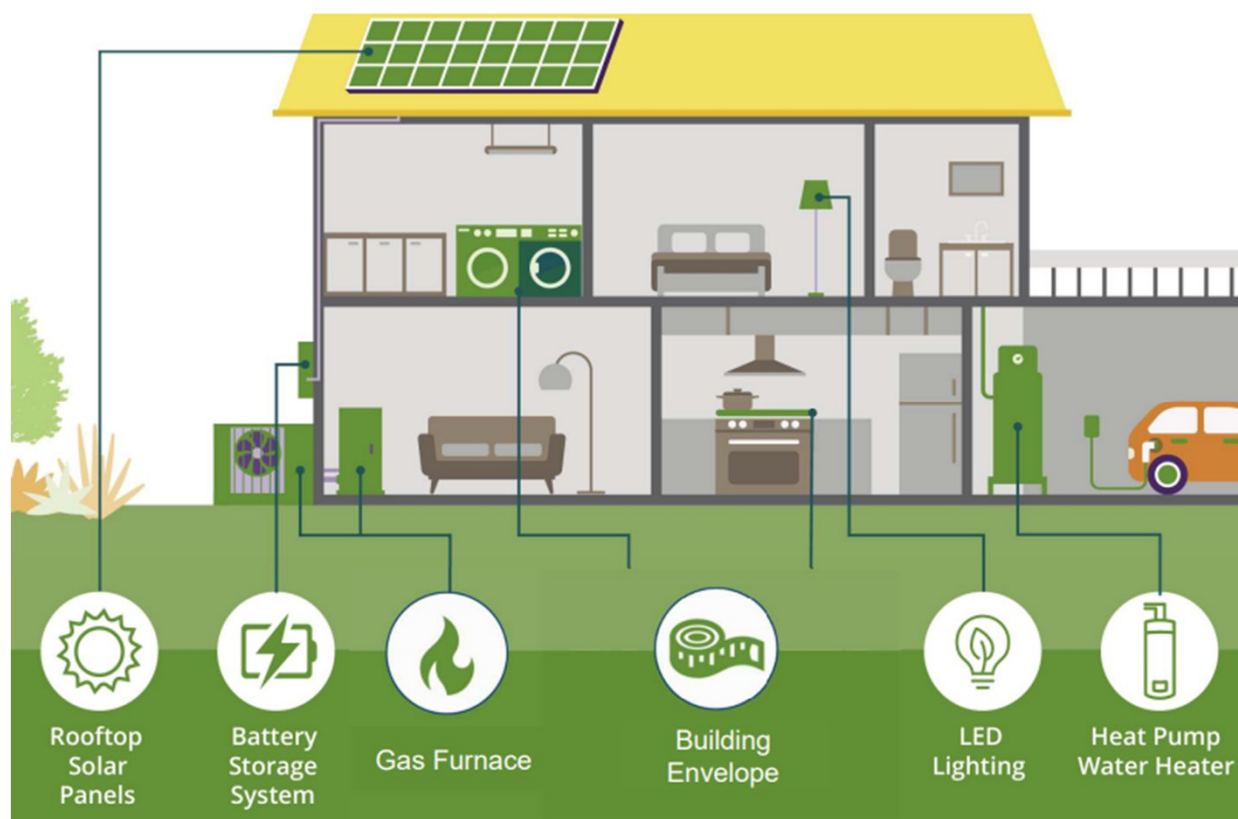
House Illustration source: Southern California Edison

All-Electric

Source  
Energy  
(EDR1)  
+6.0



# Energy Performance Approach



House Illustration source: Southern California Edison

Source  
Energy  
(EDR1)  
>6.0



# Which appliances are relevant?

## What's included?

- Space heating/cooling
- Water heating

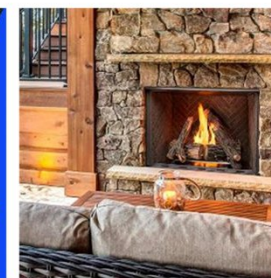


### ➤ Electric heat pumps for space and water heating

- more efficient than gas counterparts
- added safety benefits of lowering potential for carbon monoxide poisoning and gas explosions

## What's not included?

- Stoves
- Laundry
- Pools
- Fireplace/pit



# Resources for Lower Cost All-Electric Buildings

- California Electric Homes
  - Direct rebates for all new electric market rate residential units
- BUILD
  - Direct rebates for new all-electric affordable housing
- Central Coast Community Energy
  - Direct rebates for all new electric affordable housing and market rate ADUs
- 3C-REN
- Santa Barbara Clean Energy



California  
**ELECTRIC  
HOMES**



**BUILD**  
Building Initiative for Low-Emissions Development Program



Central Coast  
**Community  
Energy**



# Adoption Process & Timeline

- City Council Meetings
  - Q1 2025
  - 2/18/2025 – 2<sup>nd</sup> Reading & Public Hearing
- CA Energy Commission Approval
  - Q1-Q2 2025
- Reach Code Ordinance effective
  - Q2-Q3 2025



# Summary

- All-electric buildings improve air quality and reduce emissions
- Financial incentives for transitioning buildings & equipment to all-electric
- Energy Performance Reach Codes are reasonable & flexible
  - Allow for gas equipment and appliances
  - Cost-effective
- Proposed codes do not increase time burden on projects



# Recommendation

Introduce and conduct the first reading by title only, waiving further reading of Ordinance No. 25-\_\_ entitled, “An Ordinance of the City Council of the City of Goleta, California, Amending Title 15, Chapter 15.03 Entitled “Electrical Code” of the Goleta Municipal Code to Adopt the 2022 Edition of the California Building and Energy Code and Local Amendments Thereto and Determine the Ordinance to be Exempt from the California Environmental Quality Act.”

