File No. 220942 **Committee Item No.** 3
Board Item No. 18

COMMITTEE/BOARD OF SUPERVISORS

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Committee: Land Use and Transportation Committee **Date** October 17, 2022

Board of Supervisors Meeting **Date** November 1, 2022

Cmte	Board	
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☒	☒	2022 Findings SFGBC
☒	☒	2022 Findings Exhibit A
☒	☒	2022 Non Resid NC Cost-Eff Rpt 080822
☒	☒	2022 Single Family Cost-Eff Rpt 052022
☒	☒	DBI Ltr 082622
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☒	☒	DBI Ltr 090222
☒	☒	Referral CEQA 092122
☒	☒	CEQA Determination 101222
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Completed by: Erica Major **Date** October 13, 2022
Completed by: Erica Major **Date** October 18, 2022

[Green Building Code - Repeal of Existing 2019 Code and Enactment of 2022 Code]

Ordinance repealing the 2019 Green Building Code in its entirety and enacting a 2022 Green Building Code consisting of the 2022 California Green Building Standards Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2023; and directing the Clerk of the Board of Supervisors to forward the Ordinance to the California Building Standards Commission, as required by State law.

NOTE: **Unchanged Code text and uncodified text** are in plain Arial font.
Additions to Codes are in *single-underline italics Times New Roman font*.
Deletions to Codes are in ~~*strikethrough italics Times New Roman font*~~.
Board amendment additions are in double-underlined Arial font.
Board amendment deletions are in ~~strikethrough Arial font~~.
Asterisks (* * * *) indicate the omission of unchanged Code subsections or parts of tables.

Be it ordained by the People of the City and County of San Francisco:

Section 1. Environmental Findings. The Planning Department has determined that the actions contemplated in this ordinance comply with the California Environmental Quality Act (California Public Resources Code Sections 21000 et seq.). Said determination is on file with the Clerk of the Board of Supervisors in File No. 220942 and is incorporated herein by reference. The Board affirms this determination.

Section 2. General Findings.

(a) The California Building Standards Code is contained in Title 24 of the California Code of Regulations. It consists of 12 Parts, which are based upon model codes that are amended by the State agencies with jurisdiction over the subject matter. The California Green Building Standards Code is Part 11 of Title 24 of the California Code of Regulations.

(b) The State of California adopts a new California Building Standards Code every three years ("triennial CBSC") with supplemental amendments published in intervening years. The triennial CBSC goes into effect throughout the State of California 180 days after its publication by the California Building Standards Commission or at a later date established by the Commission. The 2022 triennial CBSC will go into effect on January 1, 2023.

(c) Local jurisdictions must enforce the California Building Standards Code but they may also enact more restrictive building standards that are reasonably necessary because of local climate, geologic, or topographical conditions. Local amendments may be made both to a triennial CBSC and also to its individual Parts during the intervening years; however, local amendments previously adopted are not automatically applicable to a triennial CBSC. Rather, they must be re-enacted with the required findings of local climate, geologic, or topographical conditions, expressly made applicable to the new triennial CBSC, and with an operative date no earlier than the effective date of the new State Code.

(d) As in past triennial CBSC adoption cycles, by this ordinance the Board of Supervisors repeals the 2019 San Francisco Green Building Code in its entirety, enacts the 2022 San Francisco Green Building Code, and re-enacts the existing local amendments to make them applicable to the 2022 California Green Building Standards Code.

(e) Pursuant to Charter Section D3.750-5, the Building Inspection Commission considered and approved San Francisco's amendments to the 2022 California Green Building Standards Code at a duly noticed public hearing that was held on August 17, 2022.

Section 3. Findings Regarding Local Conditions.

(a) California Health and Safety Code Sections 17958.7 and 18941.5 provide that before making any changes or modifications to the California Green Building Code and any other applicable provisions published by the California Building Standards Commission, the

local governing body must make an express finding that each such change or modification is reasonably necessary because of specified local conditions. The local amendments together with the required findings must be filed with the California Building Standards Commission before the local changes or modifications can go into effect.

(b) The City and County of San Francisco is unique among California communities with respect to local climate, geologic, topographical, and other conditions. A specific list of findings that support San Francisco's modifications to the 2022 California Green Building Standards Code, with a section-by-section correlation of each modification with a specific numbered finding, are contained in Exhibit A entitled "Standard Findings for San Francisco Building Standards Code Amendments."

(c) Pursuant to California Health and Safety Code Sections 17958.7 and 18941.5, the Board of Supervisors finds and determines that the local conditions described in Exhibit A constitute a general summary of the most significant local conditions giving rise to the need for modification of the 2022 California Green Building Standards Code provisions published by the California Building Standards Commission. The Board of Supervisors further finds and determines that the proposed modifications are reasonably necessary based upon the local conditions set forth in Exhibit A.

Section 4. Findings Required by California Public Resources Code and Title 24 of the California Code of Regulations.

(a) Public Resources Code Section 25402.1(h)(2) and Section 10-106 of the California Code of Regulations, Title 24, Part 1, Locally Adopted Energy Standards, authorize a local jurisdiction to adopt and enforce more restrictive local energy standards, provided that the local jurisdiction makes a determination that the local standards are cost effective and will save more energy than the current Statewide standards and provided further that the local

jurisdiction files an application for approval with the California Energy Commission together with documentation supporting the cost-effectiveness determination. Local energy standards may take effect only after the California Energy Commission has reviewed and formally approved them.

(b) Local energy standards previously adopted are not automatically applicable to a triennial CBSC. Rather, they must be re-enacted with a new cost-effectiveness study and determination based on the new State standards, and be re-approved by the California Energy Commission.

(c) Based upon the findings of a cost-effectiveness study performed on the more restrictive local standards contained in the City's proposed 2022 San Francisco Green Building Code, the Board of Supervisors hereby determines that these local energy standards are cost effective and will save more energy than the standards contained in the 2022 California Green Building Standards Code. A copy of the cost-effectiveness study is on file with the Clerk of the Board of Supervisors in File No. 220942 .

Section 5. Repeal of the 2019 San Francisco Green Building Code and Enactment of the 2022 San Francisco Green Building Code.

(a) The 2019 San Francisco Green Building Code is hereby repealed in its entirety. The San Francisco Green Building Code being repealed was enacted on November 15, 2019, by Ordinance No. 262-19, with an operative date of January 1, 2020. It was amended by Ordinance No. 3-20. These ordinances are available on the Board of Supervisors' website and in the Office of the Clerk of the Board of Supervisors.

(b) The 2022 San Francisco Green Building Code is hereby enacted. It consists of the 2022 California Green Building Standards Code and San Francisco's existing local amendments, which are re-enacted and expressly made applicable to the 2022 California

Green Building Standards Code. Copies of the 2022 California Green Building Standards Code and the stand-alone San Francisco amendments are declared to be part of Board File No. 220942 and are incorporated into this ordinance by reference as though fully set forth. Existing San Francisco amendments that are being made applicable to the 2022 California Green Building Standards Code are shown in unformatted ("plain") text and may include bold and/or italicized type; new San Francisco amendments are underlined; and deleted San Francisco amendments are in strikeout text.

Section 6. Continuance of Actions Under Prior Code. Nothing contained in this ordinance shall be construed as abating any action now pending under or by virtue of any ordinance of the City and County of San Francisco hereby repealed, nor shall this ordinance be construed as discontinuing, abating, modifying or altering any penalties accruing, or to accrue, or as waiving any right of the City under any such ordinance.

Section 7. Severability. If any section, subsection, sentence, clause, or phrase of this ordinance is, for any reason, held to be invalid, such decision shall not affect the validity of the remaining portions of this ordinance. The Board of Supervisors hereby declares that it would have passed this ordinance, and each section, subsection, sentence, clause, or phrase of this Ordinance, irrespective of the fact that any one or more sections, subsections, sentences, clauses, or phrases be declared invalid.

Section 8. Effective and Operative Dates. This ordinance shall become effective 30 days after enactment. Enactment occurs when the Mayor signs the ordinance, the Mayor returns the ordinance unsigned or does not sign the ordinance within ten days of receiving it, or the Board of Supervisors overrides the Mayor's veto of the ordinance. This ordinance shall

take effect and be in full force on and after either January 1, 2023 or its effective date if the effective date is later.

Section 9. Directions to Clerk. Upon enactment of this ordinance, the Clerk of the Board of Supervisors is hereby directed to transmit to the California Building Standards Commission pursuant to the applicable provisions of State law 1) this ordinance, 2) the Exhibit A attachment, and 3) the San Francisco modifications to the 2022 California Green Building Standards Code.

APPROVED AS TO FORM:
DAVID CHIU, City Attorney

By: /s/ Robb Kapla
ROBB KAPLA
Deputy City Attorney

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FILE NO. 220942

LEGISLATIVE DIGEST

[Green Building Code - Repeal of Existing 2019 Code and Enactment of 2022 Code]

Ordinance repealing the 2019 Green Building Code in its entirety and enacting a 2022 Green Building Code consisting of the 2022 California Green Building Standards Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2023; and directing the Clerk of the Board of Supervisors to forward the Ordinance to the California Building Standards Commission, as required by State law.

Existing Law

The Green Building Code enhances the design and construction of buildings through the use of building concepts having a reduced negative impact or positive environmental impact. The Code encourages sustainable construction practices in the categories of: planning and design, energy efficiency, water efficiency and conservation, material conservation and resource efficiency, and environmental quality. The current San Francisco Green Building Code consists of the 2019 California Green Building Standards Code and San Francisco's local amendments to the 2019 California Green Building Standards Code.

Amendments to Current Law

On January 1, 2023, a 2022 California Green Building Standards Code (also known as CalGreen) will go into effect throughout the State. The San Francisco Amendments to the 2019 California Code must be re-enacted and made applicable to the 2022 California Code. Therefore, as in past State Code adoption cycles, San Francisco will repeal its existing Green Building Code in its entirety and adopt a new Green Building Code consisting of the 2022 California Green Building Standards Code and San Francisco's local amendments to the 2022 California Green Building Standards Code ("San Francisco Amendments"). The San Francisco Amendments to the 2019 California Green Building Standards Code will be carried forward and made applicable to the 2022 California Green Building Standards Code with no or only minor technical changes.

The San Francisco Amendments are not integrated into the text of the California Codes but rather are separately printed in a stand-alone document. Therefore, the user must consult both texts in order to determine the complete code requirement. In the San Francisco Amendments, unchanged language from the 2022 California Green Building Standards Code is shaded gray, San Francisco's additions to the 2022 California Green Building Standards Code are shown in unshaded text, new (minor and technical) additions to San Francisco's amendments are underlined and deletions are shown with strikethrough.

Background Information

The State of California adopts a new California Building Standards Code every three years (the “triennial State Code”) with supplements published in intervening years. The triennial State Code goes into effect throughout the State 180 days after its publication by the California Building Standards Commission or at a later date established by the Commission. In the current triennial State Code adoption cycle, the California Building Standards Code will go into effect on January 1, 2023. The California Building Standards Code is contained in Title 24 of the California Code of Regulations, and consists of several parts that are based upon model codes with amendments made by the State agencies with jurisdiction over the subject matter. The California Green Building Standards Code is Part 11 of Title 24 of the California Code of Regulations.

Local jurisdictions must enforce the California Building Standards Code but they may also enact more restrictive building standards that are reasonably necessary because of local conditions caused by climate, geology, or topography. Local amendments may be made to a triennial State Code and also throughout the intervening years. However, local amendments previously adopted are not automatically applicable to a new triennial State Code. Rather, they must be re-enacted with the required findings of local conditions, expressly made applicable to the new triennial State Code, and with an operative date no earlier than the effective date of the new State Code.

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BOARD of SUPERVISORS

City Hall
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102-4689
Tel. No. (415) 554-5184
Fax No. (415) 554-5163
TDD/TTY No. (415) 554-5227

September 21, 2022

File No. 220942

Lisa Gibson
Environmental Review Officer
Planning Department
49 South Van Ness Avenue, Suite 1400
San Francisco, CA 94103

Dear Ms. Gibson:

On September 13, 2022, Building Inspection Commission introduced the following proposed legislation:

File No. 220942

Ordinance repealing the 2019 Green Building Code in its entirety and enacting a 2022 Green Building Code consisting of the 2022 California Green Building Standards Code, as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2023; and directing the Clerk of the Board of Supervisors to forward the Ordinance to the California Building Standards Commission, as required by State law.

This legislation is being transmitted to you for environmental review.

Angela Calvillo, Clerk of the Board

By: Erica Major, Assistant Clerk
Land Use and Transportation Committee

Attachment

c: Joy Navarrete, Environmental Planning
Don Lewis, Environmental Planning

Not defined as a project under CEQA Guidelines Sections 15378 and 15060(c)(2) because it would not result in a direct or indirect physical change in the environment.

October 12, 2022

CALIFORNIA BUILDING STANDARDS CODE
ONLINE LINKS

1. San Francisco Building Code

   2022 California Building Code, Title 24, Part 2
   https://codes.iccsafe.org/content/CABC2022P1

   2022 California Residential Code, Title 24, Part 2.5
   https://codes.iccsafe.org/content/CARC2022P1

2. San Francisco Existing Building Code

   2022 California Existing Building Code, Title 24, Part 10
   https://codes.iccsafe.org/content/CAEBC2022P1

3. San Francisco Green Building Code

   2022 California Green Building Standards Code , Title 24, Part 11
   https://codes.iccsafe.org/content/CAGBC2022P1

4. San Francisco Mechanical Code

   2022 California Mechanical Code, Title 24, Part 4
   https://epubs.iapmo.org/2022/CMC/index.html

5. San Francisco Plumbing Code

   2022 California Plumbing Code, Title 24, Part 5
   https://epubs.iapmo.org/2022/CPC/

6. San Francisco Electrical Code

   2022 California Electrical Code, Title 24, Part 3
   https://up.codes/viewer/california/ca-electric-code-2022/chapter/1/general#1

City and County of San Francisco
Department of Building Inspection

London N. Breed, Mayor
Patrick O'Riordan, C.B.O., Director

September 2, 2022

Angela Calvillo, Clerk of the Board
Board of Supervisors
#1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102-4689

Dear Ms. Calvillo:

Attached please find the six proposed ordinances (approved by the Building Inspection Commission on August 17, 2022) for the Board of Supervisors approval, which repeal the San Francisco amendments to the 2019 California Building Standards Codes and adopt replacement amendments to the new 2022 California Building Standards Codes effective January 1, 2023. Digital copies of these 2022 California Building Standards Codes are hereby provided for your reference:

1) 2022 California Building Code (https://codes.iccsafe.org/content/CABC2022P1)
2) 2022 California Residential Code (https://codes.iccsafe.org/content/CARC2022P1)
3) 2022 California Existing Building Code (https://codes.iccsafe.org/content/CAEBC2022P1)
4) 2022 California Mechanical Code (https://epubs.iapmo.org/2022/CMC/index.html)
5) 2022 California Electrical Code (https://www.nfpa.org/Login)
6) 2022 California Plumbing Code (https://epubs.iapmo.org/2022/CPC/)
7) 2022 California Green Building Code (https://codes.iccsafe.org/content/CAGBC2022P1)

In addition, the following is a list of accompanying documents:

1) Approval letter from the Building Inspection Commission
2) San Francisco Building Code and Residential Code Ordinance, Legislative Digest), Exhibit A Standard Findings, Findings, proposed amendment text (Building)
3) San Francisco Existing Building Code Ordinance, Legislative Digest, Exhibit A Standard Findings, Findings, proposed amendment text. (Existing Building)
4) San Francisco Electrical Code Ordinance, Legislative Digest, Exhibit A Standard Findings, Findings, proposed amendment text (Electrical)
5) San Francisco Mechanical Code Ordinance, Legislative Digest, Exhibit A Standard Findings, Findings, proposed amendment text (Mechanical)
6) San Francisco Plumbing Code Ordinance, Legislative Digest, Exhibit A Standard Findings, Findings, proposed amendment text (Plumbing)
7) San Francisco Green Building Code Ordinance, Legislative Digest, Exhibit A Standard Findings, Findings, proposed amendment text (Green), Cost effectiveness study.

In order for the San Francisco code amendments to coordinate with the California codes, which have an effective date of January 1, 2023, the timeline for approval and adoption requires that the codes be submitted to the Board of Supervisors on or before September 2, 2022 for introduction and assignment to the Land Use Committee (October 2022). When approved, it is proposed that the Board of Supervisors agendize readings in late October and/or early November, 2022. Upon their approval, the ordinances will be forwarded to the Mayor for signature within 10 days, followed by a 30-day wait period (ending approximately early-mid December, 2022) before filing with the California Building Standards Commission to become effective for an implementation date of January 1, 2023.

The following person may be contacted regarding this matter:

Michelle Yu,
Technical Services Division
Department of Building Inspection
Phone: (628) 652-3710

Attachments: As stated

City and County of San Francisco
Department of Building Inspection

London N. Breed, Mayor
Patrick O'Riordan, C.B.O., Director

August 10, 2022
Building Inspection Commission
49 South Van Ness Avenue, Suite 500
San Francisco, CA 94103

Re: Proposed amendments to the 2022 California Building Standards Code, CCR Title 24

Honorable Members of the Commission:

Starting on May 6, 2022 and ending on July 13, 2022, the Code Advisory Committee and associated sub-committees have reviewed and approved all of the 2022 San Francisco amendments to the 2022 California Title 24 Building Standards Code. The Code Advisory Committee recommends the Building Inspection Commission approve 2022 San Francisco amendments as written.

The San Francisco amendments to the 2022 California Building Standards Codes approved and recommended by this Committee are:

1. 2022 San Francisco Building Code (SFBC) Amendments (06/08/22 Meeting)
2. 2022 San Francisco Existing Building Code (SFEBC) Amendments (05/11/22 Meeting)
3. 2022 San Francisco Mechanical Code (SFMC) Amendments (05/11/22 Meeting)
4. 2022 San Francisco Electrical Code (SFEC) Amendments (05/11/22 Meeting)
5. 2022 San Francisco Plumbing Code (SFPC) Amendments (05/11/22 Meeting)
6. 2022 San Francisco Green Building Code (SFGB) Amendments (07/13/22 Meeting)

These documents are transmitted to you for your further action and a final approval to send them on to the Board of Supervisors. If you have any questions, please call me at (628) 652-3721 or email thomas.fessler@sfgov.org.

Respectfully submitted

Thomas Fessler
DBI Technical Services Division
Secretary to the Code Advisory Committee

cc. Patrick O'Riordan, C.B.O., Director
Neville Pereira, P.E., C.B.O., Deputy Director
Michelle Yu, Manager
Stephen Harris, S.E, Chair, Code Advisory Committee
Ray Law, Legislative Affairs

Attach: Proposed Draft SFBC, SFEBC, SFMC, SFEC, SFPC, SFGBC

BUILDING INSPECTION COMMISSION (BIC)

Department of Building Inspection **Voice (628) 652 -3510**
49 South Van Ness Avenue, Suite 500 San Francisco, California 94103

August 26, 2022

Ms. Angela Calvillo
Clerk of the Board
Board of Supervisors, City Hall
1 Dr. Carlton B. Goodlett Place, Room 244
San Francisco, CA 94102-4694

RE: Code amendments to the 2022 California Building Standards Code, including the Building, Existing Building, Residential, Mechanical, Plumbing, Electrical, and Green Building Codes and recommend approval to the Board of Supervisors.

Dear Ms. Calvillo:

On August 17, 2022 the Building Inspection Commission held a public hearing on the proposed Code amendments referenced above.

The Commission voted unanimously (4-0) to recommend that the Board of Supervisors approve the amendments.

The Commissioners voted as follows:

President Bito	Yes	Vice-President Tam	Yes
Commissioner Sommer	Yes	Commissioner Neumann	Excused
Commissioner Alexander-Tut	Yes		

Enclosed please find the Code Advisory Committee's recommendation to the Building Inspection Commission. Under separate cover, copies of the proposed amendments will follow from the Technical Services Division of the Department of Building Inspection.

Should you have any questions, please do not hesitate to call me at (628) 652-3510.

Sincerely,

Sonya Harris
Commission Secretary

cc: Patrick O'Riordan, C.B.O., Director
Mayor London N. Breed
Supervisor Shamann Walton
Supervisor Connie Chan
Supervisor Matt Dorsey
Supervisor Rafael Mandelman
Supervisor Gordon Mar
Supervisor Myrna Melgar
Supervisor Aaron Peskin
Supervisor Dean Preston
Supervisor Hillary Ronen
Supervisor Ahsha Safai
Supervisor Catherine Stefani
Deputy City Attorney Robb Kapla
Deputy City Attorney Peter Miljanich

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Last modified: 2022/05/20
Revision: 1.0

2022 Cost-effectiveness Study: Single Family New Construction

Prepared by:
Frontier Energy, Inc
Misti Bruceri & Associates, LLC

Prepared for:
Kelly Cunningham, Codes and Standards Program, Pacific Gas and Electric

SDGE A Sempra Energy utility
SOUTHERN CALIFORNIA EDISON Energy for What's Ahead
PG&E Pacific Gas and Electric Company

Legal Notice

Acronym List

2022 PV$ – Present value costs in 2022

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_2 – 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)**
X/XX/2022	Original Release	NA

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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 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.

The following summarizes key results from the study:

- 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 Reach Codes Team found all-electric new construction to be feasible and cost effective based on TDV in all cases. In many cases all-electric code minimum 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 natural gas rates result in lower overall utility bills.
- 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. 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 an all-electric reach code for single family buildings also include an efficiency requirement with EDR2 margins consistent with the all-electric code minimum package.
- The code compliance margins for the ADU all-electric code minimum package are lower than for the single family prototype and code compliance can be more challenging for smaller dwelling units. As a result, the Reach Codes Team does not recommend an additional efficiency requirement for all-electric ADU ordinances.
- Electrification combined with increased PV capacity results in utility cost savings and was found to be On-Bill cost effective in all cases. These results were based on today's net energy metering rules and do not account for future changes to utility agreements, which are expected to decrease the value of PV to the consumer.
- For jurisdictions interested in a reach code that allows for mixed fuel buildings, the mixed fuel efficiency, PV, and battery package was found to be cost effective based on TDV only for single family buildings in all climate zones except Climate Zone 7. Cost effectiveness was marginal because of the high cost of the battery system. EDR2 margins ranged from 8 to 30 for the cost-effective packages. The ADU mixed fuel efficiency + PV +battery package was only cost-effective in about half of the climate zones as shown in Table 20. The ADU mixed fuel efficiency + PV package was cost-effective everywhere.
- Applying the CARE rates has the overall impact to increase utility cost savings for an all-electric building compared to a code compliant mixed fuel building, improving On-Bill cost-effectiveness.

This 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. 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. Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at info@localenergycodes.com.

1 Introduction

This report documents cost-effective 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).[1] Packages include combinations of efficiency measures, on-site renewable energy, and battery energy storage.

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, 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.

[1] 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 Beta software available for 2022 Title 24 Code compliance analysis, CBECC-Res 2022.1.0. At the time analysis was conducted for this report, the 2022 software had not been approved by the Energy Commission.

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 (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 efficient 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, replacements, 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 for measures with equipment lifetimes less than the 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 (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

- $NPV\ Savings = PV\ of\ lifetime\ benefit - PV\ of\ lifetime\ cost$

Equation 2

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

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

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

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 CBECC-Res simulation software reports TDV values normalized by area (per square foot). The present value of the energy cost savings in dollars is calculated by multiplying the TDV savings by a NPV factor, also 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

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

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.

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 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 PV generation, the approved NEM2 tariffs were applied along with minimum daily use billing and mandatory non-bypassable charges. Future changes to the NEM tariffs are likely and the California Public Utilities Commission (CPUC) has issued a proposed decision with suggested changes that is expected to be finalized in 2022.[2] The ADU was assumed to have a separate electric and gas meter from the main house.

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

Table 1. Utility Tariffs Used Based on Climate Zone

Climate Zones	Electric / Gas Utility	Electricity	Natural Gas
IOUs			
1-5,11-13,16	PG&E / PG&E	E-TOU Option C	G1
5	PG&E / SoCalGas	E-TOU Option C	GR
6, 8-10, 14, 15	SCE / SoCalGas	TOU-D Option 4-9	GR
7, 10, 14	SDG&E / SDG&E	TOU-DR-1	GR
POUs			
4	CPAU / CPAU	E-1	G-2
12	SMUD / PG&E	R-TOD (RT02)	G1

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 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.[3] GHG emissions are reported as average annual metric tons of CO_2 equivalent over the 30-year building lifetime.

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.

[3] 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).

Furthermore, EDR2 is composed of two components for compliance purposes. The Efficiency EDR2 which represents the energy efficiency features of a home. The PV/Flexibility EDR2 includes the effects of PV and battery storage systems. Total EDR2 combines 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 are required:

1. The Proposed EDR1 must be equal to or less than the 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 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 on building efficiency beyond the minimum required and subsequently reduce the PV generation capacity required to achieve the required Total EDR2 but 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. Referencing the margin results in similar requirements across a variety of designs. 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

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

3 Prototypes, Measure Packages, and Costs

This section describes the prototypes and the scope of analysis drawing from previous 2019 Reach Code research where necessary.

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 to 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^2	2,700 ft^2	625 ft^2
Num. of Stories	1	2	1
Num. of Bedrooms	3	3	1
Window-to-Floor Area Ratio	20%	20%	20%

The Energy Commission's protocol for the two single family prototypes is to weight the simulated energy impacts by a factor that represents the distribution of single-story and two-story homes being built statewide. This study assumed 50

percent single-story and 50 percent two-story. Simulation results in this study are characterized according to this ratio, which is approximately equivalent to a 2,400-square foot (ft^2) house.[4] 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. Each prototype building has the following features:

- Slab-on-grade foundation.
- Vented attic.
- High performance attic in climate zones where prescriptively required (CZ 4, 8-16) with insulation installed at the ceiling and below the roof deck per Option B. (Refer to Table 150.1-A in the 2022 Standards.)
- Ductwork located in the attic.

Table 3 describes additional 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 and water heating establishing a heat pump baseline. In each climate zone one heat pump is prescriptively required. 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.

[4] 2,400 ft^2 = (50% x 2,100 ft^2) + (50% x 2,700 ft^2)

Table 3: Base case Characteristics of the Prototypes

Characteristic	Single Family	ADU
Space Heating/Cooling[1,2]	CZs 1-2,5-12,15-16: Natural gas furnace, split AC 80 AFUE, 14 SEER, 11.7 EER CZs 3-4,13-14: Split heat pump – 8.2 HSPF, 14 SEER, 11.7 EER	Same as single family
Water Heater[1,2]	CZs 1-2,5-12,15-16: Heat pump water heater (HPWH) UEF = 2.0 located in the garage CZs 3-4,13-14: 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[3]
Hot Water Distribution	Code minimum, all hot water lines insulated CZs 1,16: Basic compact distribution credit	Same as single family
Drain Water Heat Recovery Efficiency	CZ 16: 65%, equal flow to shower & water heater	Same as single family
Cooking	Natural Gas	Same as single family
Clothes Drying	Natural Gas	Same as single family
PV System	Sized as 'Standard Design PV' offsetting 100% of electricity use for space cooling, ventilation, lighting, appliance, & other miscellaneous electric loads. Size differs by climate zone and prototype ranging from 2.29 kW to 5.68 kW.	PV is not required when the PV system size required is less than 1.8 kW. This occurs in Climate Zones 1-9, 12, 14, and 16. In Climate Zones with PV, PV size ranges from 1.8 kW to 2.45 kW.

[1]Equipment efficiencies are equal to minimum federal appliance efficiency standards.
[2]AFUE = annual fuel utilization efficiency. SEER = seasonal energy efficiency ratio. EER = energy efficiency ratio. HSPF = heating seasonal performance factor. UEF = uniform energy factor.
[3]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.

3.3 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.

Table 5 summarizes the 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.[5] 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 2022 (2022 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. However, it's recognized that local costs may differ and that inflation and supply chain issues may also impact costs.

[5] 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.

3.3.1 Efficiency, Solar PV, and Batteries

Following are descriptions of each of the measures evaluated under this analysis and applied in at least one of the packages presented in this report.

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)[6] 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).

Improved Fenestration: Reduce window U-factor to 0.24. The prescriptive U-factor is 0.30 in all climates. In climate zone 16 where heating loads dominate, an increase in solar heat gain coefficient (SHGC) from the default assumption of 0.35 to 0.50 was evaluated in addition to the reduction in U-factor.

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 2022 Title 24 specifies a prescriptive ASR of 0.20 for Climate Zones 10 through 15.

Increased Ceiling Insulation: Increase ceiling level insulation to 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. 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).

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.[7] 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 prototypes only.

Ductless Mini-Split Heat Pump: In the ADU prototype replace the ducted split system with 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.

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

[6] Whole house leakage tested at a pressure difference of 50 Pascals between indoors and outdoors.
[7] The duct systems in the Central Valley Research Homes Project Final Project Report are illustrative of this approach (Proctor, Wilcox, & Chitwood, 2018).

heater from an exterior to an interior garage wall. CBECC-Res software assumes a 30% reduction in distribution losses for the basic credit.

Solar PV: Installation of on-site PV is required in the 2022 residential code. 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.[8] In all cases, PV is evaluated in CBECC-Res according to the California Flexible Installation (CFI) assumptions.

The Reach Codes Team used two options within the CBECC-Res software for sizing the PV system, described below. The first option was applied in the base case simulations and packages where the PV system size was not changed from the minimum system size required. For the PV packages, the second option was used with a scaling of 100 percent. The Reach Codes Team evaluated an all-electric single family and ADU home with a PV system sized to offset 100 and 90 percent of the total calculated electricity use. Sizing to 100 percent proved to be more cost-effective based on customer utility bills in most cases. As a result, the PV packages were sized to offset 100 percent of electricity use.

- Standard Design PV – the same PV capacity as is required for the Standard Design case[9]
- Specify PV System Scaling – a PV system sized to offset a specified percentage 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 kWh. 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. Table 4 summarizes the PV capacities for the base case packages.

[8] NEM rules apply to the IOU territories only.
[9] 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.

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

Climate Zone	Base Package	
	Single Family	ADU
CZ01	3.54	0
CZ02	2.99	0
CZ03	2.81	0
CZ04	2.90	0
CZ05	2.62	0
CZ06	2.64	0
CZ07	2.84	0
CZ08	3.13	0
CZ09	2.97	0
CZ10	3.19	1.74
CZ11	3.91	2.07
CZ12	3.12	0
CZ13	4.08	2.11
CZ14	3.16	0
CZ15	5.33	2.56
CZ16	2.90	0

Battery Energy Storage: A battery system was evaluated in CBECC-Res with control type set to “Advanced Demand Response Control” and with default efficiencies of 95% for both charging and discharging. The “Advanced Demand Response Control” option assumes the battery system will charge or discharge depending on the needs of the grid.

Table 5: Incremental Cost Assumptions

Measure	Performance Level	Incremental Cost (2022 PV$)[1]		Source & Notes
		Single Family	ADU	
Non-Preempted Measures				
Reduced Infiltration	3.0 vs 5.0 ACH50	$591	$362	$0.115/ft^2 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^2 window area based on analysis conducted for the 2019 and 2022 Title 24 cycles (Statewide CASE Team, 2018).
Cool Roof - Aged Solar Reflectance	0.25 vs 0.20	$219	$53	$0.07per ft^2 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.
Low Pressure Drop Ducts (Fan W/cfm)	0.35 vs 0.45	$99	$49	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	$0	$0	No cost for laying ducts on attic floor versus suspending, in some cases there will be cost savings.
Ductless Mini-Split Heat Pump	Ductless system meeting the VCHP credit vs. ducted split heat pump	n/a	$944	Costs were developed based on costs 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,

Measure	Performance Level	Incremental Cost (2022 PV$)[1]		Source & Notes
		Single Family	ADU	
				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 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 + Battery				
PV System	First Cost, per Watt	$3.21	$3.21	First costs are from LBNL's Tracking the Sun 2021 costs (Barbose, Darghouth, O'Shaughnessy, & Forrester, 2021) and represent median costs in California in 2020 of $3.90/WDC for residential systems. The first cost was reduced by the solar energy Investment Tax Credit of 30%.[2] Costs are presented as the average of 2023, 2024, and 2025.
	Inverter replacement, per Watt	$0.14	$0.14	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).
	Maintenance, per Watt	$0.31	$0.31	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).
Battery	First cost	$617/kWh	$617/kWh	Costs are based on research conducted for the 2021 Batteries in Single Family Homes reach code report (Statewide Reach Codes Team, 2021a). $1,000/kWh first cost in 2020 based on Self-Generation Incentive Program (SGIP) residential participant cost data. To estimate the first cost in future years this was reduced by 7% annually based on SDG&E's Behind-the-Meter Battery Market Study (E-Source companies, 2020). The first cost is reduced by the solar energy Investment Tax Credit of 30%.[2] Costs are presented as the average of 2023, 2024, and 2025. No SGIP incentives are included.
	Replacement cost	$505/kWh	$505/kWh	

Measure	Performance Level	Incremental Cost (2022 PV$)[1]		Source & Notes
		Single Family	ADU	
				Replacement cost at year 10 and 20 was calculated based on the 2023 cost reduced by 7% annually over the next 10 years for a future value cost of $389 (present value of $290 in year 10 and $216 in year 20).

[1]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.
[2]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

3.3.2 All-Electric

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. In these cases, 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 were included.

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.

Incremental costs for natural gas infrastructure to a single family building are presented in Table 6 through Table 11**Error! Reference source not found.**. 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. 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. The CA IOU costs for single family homes presented **Error! Reference source not found.**are based primarily on cost data provided by PG&E.

Table 6 presents assumed gas main distribution line extension costs within gas CA IOU territory. Total distribution line extension costs are based on cost data provided by PG&E for new greenfield development. Total costs are reduced to account for deductions per the Utility Gas Main Extensions rules.[10] These rules categorize distribution line extensions as “refundable” costs, which are offset or subsidized by all other ratepayers. Refundable costs are first subsidized by appliance allowances, which are defined in Table 7. If there are additional costs in excess of the allowances, the developer has the option to either be refunded for the remaining amount over ten years or receive a 50 percent discount at time of application. The latter discount option is assumed in this analysis and is more commonly used by developers (California Public Utilities Commission, 2022). Two scenarios are presented in Table 6 since the appliance allowances differ by type of appliance. One is for the base case home with a prescriptive heat pump space heater which assumes a gas water heater, gas cooking, and gas clothes dryer (Climate Zones 3, 4, 13, and 14). The second is for the base case home with a prescriptive heat pump water heater which assumes a gas furnace, gas cooking, and gas clothes dryer. and a natural gas furnace for space heating (Climate Zones 1, 2, 5 through 12, 15, and 16).

The costs less the deductions were applied under the On-Bill cost-effectiveness methodology. The total costs before the deductions were applied under the TDV cost-effectiveness methodology to better reflect the full cost of gas main extensions since the deductions are subsidized by ratepayers and recovered via revenue from customers. This follows the analysis approach in the 2019 reach code study (Statewide Reach Codes Team, 2019) and was based on input received from the Energy Commission and agreement from the Reach Codes technical advisory team that the approach is appropriate. TDV cost savings impacts extend beyond the customer and account for societal impacts of energy use. Accounting for the full cost of the infrastructure upgrades was determined to be justified when evaluating under the TDV methodology.

The CPUC issued a Proposed Decision in August 2022 that recommends eliminating the subsidies effective July 1, 2023. At the time of publishing this report there had been no ruling on this decision and therefore this analysis assumes

[10] PG&E Rule 15: 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.

the existing rules will remain in place through the 2022 code cycle. A sensitivity analysis of how the results would change if the Proposed Decision were adopted is included in the results of this report.

Table 6. Single Family IOU Natural Gas Main Distribution Line Extension Costs

	Total	Less Gas Extension Rule Deductions[1]		
		PG&E	SoCalGas	SDG&E
Gas Water Heater Base	$1,020	$0	$0	$24
Gas Space Heater Base		$0	$0	$52

[1]After Utility Gas Main Extension Rule deductions.

Table 7. Residential IOU Gas Line Extension Appliance Allowances

Appliance	PG&E	SoCalGas	SDG&E
Water Heating	$1,391	$682	$1,138
Space Heating	$987	$818	$987
Oven/Range	$84	$152	$201
Dryer Stub	$24	$160	$289
Total - Gas Water Heater Base	**$1,499**	**$994**	**$1,628**
Total – Gas Space Heater Base	**$1,095**	**$1,130**	**$1,477**

Table 8 presents costs for the extension of service lines from a main distribution line to the home within gas CA IOU territory. These costs are based on data provided by PG&E excluding trenching. Costs are presented separately for a new subdivision in an undeveloped area as well as an infill development. 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.

Table 8. Single Family IOU Natural Gas Service Line Extension Costs

New Subdivision	Infill Development	Average (80% New, 20% Infill)
$1,300	$6,750	$2,390

Table 9 presents other relative costs within gas CA IOU territory including gas meter installation and IOU plan review. These costs are based on data provided by PG&E.

Table 9. Single Family IOU Other Natural Gas Infrastructure Costs

Meter	$300
Plan Review	$850

Table 10 presents total costs including distribution and service line extensions, meter installation and plan review for the three gas CA IOUs for the two base case scenarios. Costs are based on the average service line extension costs from Table 8. 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 10. Single Family IOU Total Natural Gas Infrastructure Costs[1]

	Total	Less Gas Extension Rule Deductions[2]		
		PG&E	SoCalGas	SDG&E
Total - Gas Water Heater Base	$4,560	$3,540	$3,553	$3,540
Total - Gas Space Heater Base		$3,540	$3,540	$3,540

[1]Based on average service line extension costs from Table 8.
[1]After Utility Gas Main Extension Rule deductions.

CPAU provides gas service to its customers and therefore separate costs were evaluated based on CPAU gas service connection fees.[11] Table 11 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 most of the development is infill.

Table 11. Single Family CPAU Total Natural Gas Infrastructure Costs

Item	Cost
Service Extension	$5,892
Meter	$1,012
Plan Review Costs	$924
Total	**$7,828**

Table 12 presents incremental costs for natural gas infrastructure for the detached ADU. These costs are directly from the 2019 detached ADU reach code report (Statewide Reach Codes Team, 2021b) and were obtained from interviews and RS Means. For the ADU scenario it's assumed that natural gas 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 will need to be slightly upgraded for the all-electric design.

[11] 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 12. ADU Utility Infrastructure Costs

Mixed Fuel Measure	Mixed Fuel Cost	All-Electric Measure	All-Electric Cost	All-Electric Incremental Cost
Site natural gas service extension	$1,998	No site natural gas service	$0	($1998)
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
Totals	**$7,704**		**$6,901**	**($1,024)**

Equipment lifetimes applied in this analysis for the water heating and space conditioning measures are summarized in Table 13. 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. Present value replacement costs are included in the total lifetime incremental costs.

Table 13: Lifetime of Water Heating & Space Conditioning Equipment Measures

Measure	Lifetime
Gas Furnace	17.5
Air Conditioner	17.5
Heat Pump	15
Gas Tankless Water Heater	20
Heat Pump Water Heater	15

Appliance incremental costs are shown in Table 14. Replacement costs are applied to HVAC and DHW equipment over the 30-year evaluation period. Costs were estimated to reflect costs to the building owner. All costs are provided as present value in 2022 (2022 PV$). Costs due to variations in furnace, air conditioner, and heat pump capacity by climate zone were not accounted for.

The Reach Codes Team determined that the typical first installed cost for electric appliances is similar to that for natural gas appliances. Cost differences include equipment cost and installation, costs for natural gas piping from the meter to the appliance, and costs for electrical wiring to service the appliances.

Space Heater: Typical HVAC incremental costs were based on material costs from the AC Wholesalers website and labor costs from 2022 RS Means. In most cases the Reach Codes Team found that the material costs were slightly higher for the heat pump, but the labor costs were slightly higher for the gas furnace/AC installation. Costs were calculated for capacities ranging from a 2-ton to a 5-ton and the incremental costs used in this study were based on a weighted average of the expected nominal capacities from CBECC-Res autosizing results for the 2,100 square foot

prototype. Incremental replacement costs for the heat pump are based on a 17.5-year lifetime for the gas furnace and air conditioner and a 15-year lifetime for the heat pump. Residual value of the gas furnace/AC at the end of the 30-year analysis period was accounted for to represent the remaining life of the equipment.

Water Heater: Various cost sources were reviewed and the Reach Codes Team determined that installed first costs for a garage installed tankless gas water heater and HPWH are very similar and no incremental cost was applied for the equipment and installation (see below for details on costs for gas piping and electrical wiring). This accounts for slightly higher equipment costs for the HPWH but lower installation labor due to the elimination of the combustion gas venting. Incremental replacement costs account for a 15-year HPWH lifetime and a 20-year lifetime for the gas tankless water heater. Residual value of the gas tankless at the end of the 30-year analysis period was accounted for to represent the remaining life of the equipment. For the ADU analysis the water heater is evaluated within the conditioned space with the supply air ducted from the outside. An HVAC contractor provided a cost estimate for supply air ducting through the wall in an ADU where the water heater is in an interior room adjacent to an exterior wall. The estimated total cost for this was $652.

A high efficiency HPWH that meets the Northwest Energy Efficiency Alliance (NEEA)[12] Tier 3 rating was also evaluated. This is representative of most HPWHs that are on the market today. While the Reach Codes Team evaluated a HPWH that just meets the federal minimum efficiency standards of 2.0 UEF to satisfy federal preemption requirements, the Reach Codes Team was not able to identify any 2.0 UEF products that are available. As a result identifying cost differences between these two HPWH products was difficult. Aligned with prior recent reach code studies the first equipment cost for the 2.0 UEF HPWH was assumed to be 90% of that for a NEEA Tier 3 HPWH. No incremental replacement costs are applied for the NEEA Tier 3 relative to a 2.0 UEF as it's assumed that in 15 years' time efficiency standards will have met up with the NEEA Tier 3 standard.

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 also similar.

Electric Service Upgrade: 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 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 comparable gas appliance. Incremental costs are applied for the space heater, 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 heater 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. 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

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

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 14. Single Family All-Electric Appliance Incremental Costs

Measure	Incremental Cost (2022 PV$)		
	First Cost	Replacement Cost	Total Lifetime Financed
Heat Pump vs Gas Furnace/Split AC			
Equipment & Installation	($151)	$703	$533
Electric Service Upgrade	$43	$0	$49
In-House Gas Piping	($580)	$0	($651)
Total	**($688)**	**$703**	**($69)**
Heat Pump Water Heater vs Gas Tankless			
Equipment & Installation	$	$652	$652
Electric Service Upgrade	$43	$0	$49
In-House Gas Piping	($580)	$0	($651)
Total	**($537)**	**$652**	**$49**
NEEA Tier 3 HPWH vs Federal Minimum HPWH			
Equipment	$150	$0	$168
Total	**$150**	**$0**	**$168**
Electric Resistance vs Gas Cooking			
Equipment & Installation	$0	$0	$0
Electric Service Upgrade	$100	$0	$113
In-House Gas Piping	($580)	$0	($651)
Total	**($480)**	**$0**	**($539)**
Electric Resistance vs Gas Clothes Drying			
Equipment & Installation	$0	$0	$0
Electric Service Upgrade	$0	$0	$0
In-House Gas Piping	($580)	$0	($651)
Total	**($580)**	**$0**	**($651)**

Table 15. ADU All-Electric Appliance Incremental Costs

Measure	Incremental Cost (2022 PV$)		
	First Cost	Replacement Cost	Total Lifetime Financed
Heat Pump vs Gas Furnace/Split AC			
Equipment & Installation	($151)	$703	$533
Electric Service Upgrade	$43	$0	$49
In-House Gas Piping	($580)	$0	($651)
Total	**($688)**	**$703**	**($69)**
Heat Pump Water Heater vs Gas Tankless			
Equipment & Installation	$652	$652	$1,384
Electric Service Upgrade	$43	$0	$49
In-House Gas Piping	($580)	$0	($651)
Total	**$115**	**$652**	**$781**
NEEA Tier 3 HPWH vs Federal Minimum HPWH			
Equipment	$150	$0	$168
Total	**$150**	**$0**	**$168**
Electric Resistance vs Gas Cooking			
Equipment & Installation	$0	$0	$0
Electric Service Upgrade	$100	$0	$113
In-House Gas Piping	($580)	$0	($651)
Total	**($480)**	**$0**	**($539)**
Electric Resistance vs Gas Clothes Drying			
Equipment & Installation	$0	$0	$0
Electric Service Upgrade	$0	$0	$0
In-House Gas Piping	($580)	$0	($651)
Total	**($580)**	**$0**	**($651)**

3.4 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 Code Minimum: This package meets all the prescriptive requirements of the 2022 Title 24 Code. In some instances, the prescriptive minimum package did not comply with code and efficiency measures were added to meet minimum compliance requirements. The added efficiency measures can be found in Table 44 and Table 45.
2. Efficiency Only: This package uses only efficiency measures that don't trigger federal preemption issues including envelope and water heating or duct distribution efficiency measures.
3. Efficiency + NEEA (Preempted): This package was evaluated for the all-electric homes only and shows an alternative design that applies water heating equipment that is more efficient than federal standards meeting the NEEA Tier 3 rating. The Reach Codes Team considers this more reflective of how builders meet above code requirements in practice.

4. Efficiency + PV: Using the Efficiency Package as a starting point, PV capacity was added to offset most of the estimated electricity use.
5. Efficiency + PV + Battery: Using the Efficiency & PV Package as a starting point, a battery system was added. For mixed-fuel homes the package of efficiency measures differed from the Efficiency Package in some climate zones to arrive at a cost effective solution.

4 Results

4.1 2022 Metrics and Compliance

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. The impacts for the single family home and the ADU are presented in Figure 1 and Figure 2, respectively. The all-electric single family home prototype is code compliant with both EDR1 (source energy) and efficiency EDR2 (TDV energy) in all climate zones except Climate Zone 16. In addition to this climate zone, the all-electric ADU is also not compliant in Climate Zones 4 through 10 and 13 through 15. The four gas appliance single family home is presented in Figure 3. This case is not code compliant in any climate zone.

This analysis illustrates a couple of interesting points. One is that the new 2022 compliance metrics are important drivers encouraging electrification. The compliance penalties assessed the four gas appliance home scenarios are significant and will require deep efficiency measures to overcome. Another is that the 2022 Title 24 Code's new source energy metric combined with the heat pump baseline encourage all-electric construction, providing a compliance benefit, at least in larger homes, that allows for some amount of prescriptively required building efficiency to be traded off and still comply when using the performance method.

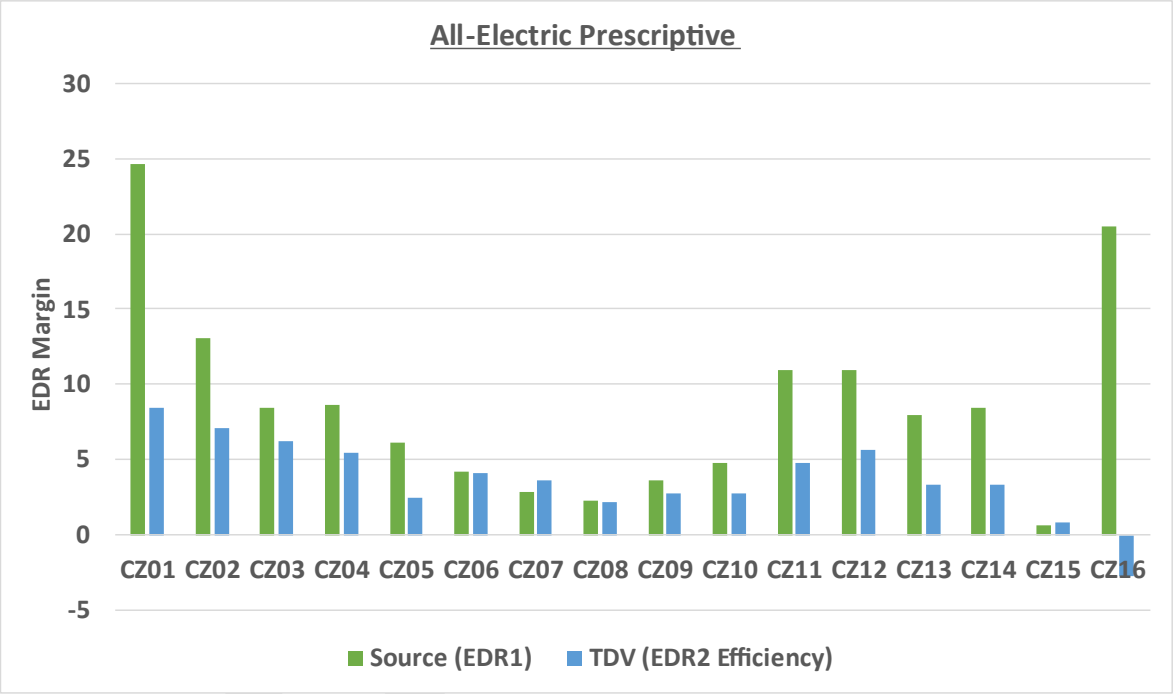

Figure 1: Single Family All-Electric Home Compliance Impacts

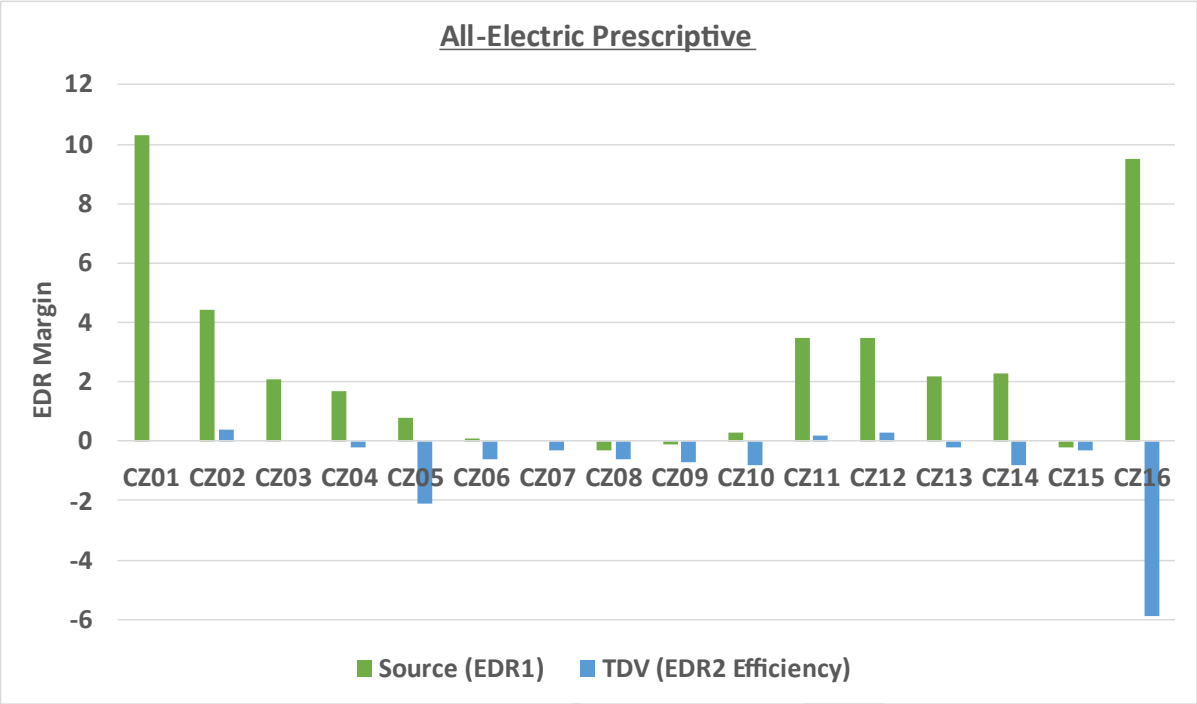

Figure 2: ADU All-Electric Home Compliance Impacts

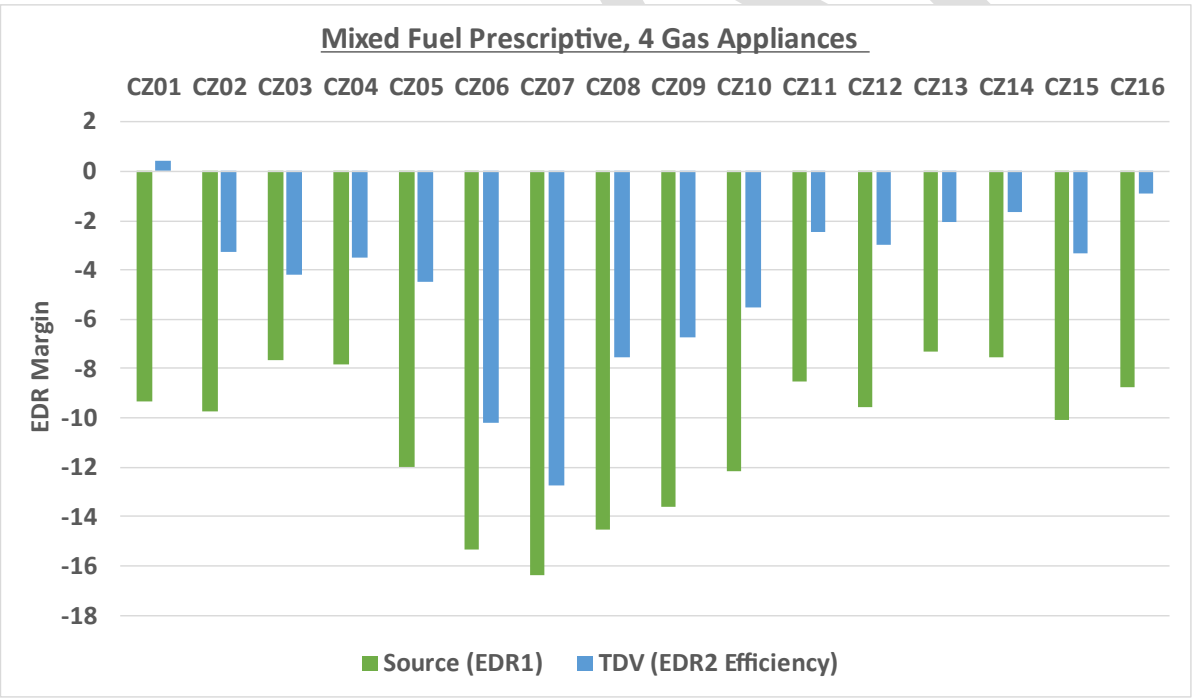

Figure 3: Single Family Four Gas Appliance Home Compliance Impacts

4.2 All-Electric Code Minimum Results

Table 16 shows results for the single family all-electric code minimum case compared to the 2022 baseline. This package reflects the prescriptive minimum requirements except in Climate Zone 16, where efficiency measures were added to meet minimum code compliance. The added efficiency measures are described in Table 44 and Table 45. Utility cost savings are negative, indicating an increase in utility costs for the all-electric building, in all cases except in CPAU and SMUD territories. In all cases the incremental cost is negative, which reflects a cost savings for the all-electric building due to eliminating the gas infrastructure costs.

The package is cost effective based on TDV in all cases; however, it's only cost-effective On-Bill in Climate Zone 4 CPAU territory, CZ6, CZ8, CZ9, CZ10 SCE/SCG territory, CZ12 SMUD territory, CZ13, CZ14 SCE/SCG territory and CZ15. Table 17 shows the all-electric base case results for the ADU. The conclusions are similar for the ADU as for the single family analysis. This package reflects the prescriptive minimum requirements except in Climate Zones 5, 6, 7, 15, and 16, where efficiency measures were added to meet minimum code compliance.

A summary of measures included in each package is provided in Appendix 7.3 Summary of Measures by Package.

Table 16. Single Family Cost-Effectiveness: All-Electric Code Minimum

Climate Zone	Electric /Gas Utility	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	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	8.3	-4,628	400	1.5	($725)	($10,956)	($5,288)	($5,234)	0.5	($5,721)	>1	$7,362
CZ02	PGE	5.7	-3,170	247	0.8	($584)	($10,168)	($5,288)	($5,234)	0.5	($4,933)	>1	$7,185
CZ03	PGE	4.7	-2,413	171	0.7	($474)	($9,133)	($5,136)	($5,116)	0.6	($4,017)	88.7	$6,191
CZ04	PGE	3.7	-2,233	163	0.7	($433)	($8,254)	($5,136)	($5,116)	0.6	($3,138)	>1	$6,705
CZ04	CPAU	3.7	-2,233	163	0.7	$21	$3,274	($9,424)	($9,931)	>1	$13,205	>1	$6,705
CZ05	PGE	1.1	-2,123	133	0.4	($455)	($9,038)	($5,288)	($5,234)	0.6	($3,803)	3.5	$4,571
CZ05	PGE/SCG	1.1	-2,123	133	0.4	($455)	($9,027)	($5,288)	($5,234)	0.6	($3,793)	3.5	$4,571
CZ06	SCE/SCG	2.5	-1,481	84	0.3	($269)	($5,120)	($5,288)	($5,234)	1.0	$115	4.4	$4,937
CZ07	SDGE	2.3	-1,328	69	0.2	($431)	($10,106)	($5,288)	($5,234)	0.5	($4,872)	4.2	$4,877
CZ08	SCE/SCG	0.6	-1,331	67	0.2	($249)	($4,864)	($5,288)	($5,234)	1.1	$371	3.9	$4,746
CZ09	SCE	1.2	-1,513	85	0.3	($269)	($5,109)	($5,288)	($5,234)	1.0	$126	4.5	$4,974
CZ10	SCE/SCG	1.1	-1,777	107	0.3	($307)	($5,720)	($5,288)	($5,234)	0.9	($486)	4.9	$5,080
CZ10	SDGE	1.1	-1,777	107	0.3	($632)	($14,676)	($5,288)	($5,234)	0.4	($9,442)	4.9	$5,080
CZ11	PGE	3.5	-2,934	227	0.7	($447)	($7,213)	($5,288)	($5,234)	0.7	($1,979)	>1	$6,930
CZ12	PGE	4.0	-2,751	213	0.7	($441)	($7,321)	($5,288)	($5,234)	0.7	($2,086)	>1	$6,797
CZ12	SMUD/PGE	4.0	-2,751	213	0.7	$55	$4,419	($5,288)	($5,234)	>1	$9,653	>1	$6,797
CZ13	PGE	2.1	-2,099	154	0.6	($338)	($6,117)	($5,136)	($5,116)	0.8	($1,001)	>1	$6,680
CZ14	SCE/SCG	1.6	-2,301	159	0.6	($370)	($6,639)	($5,136)	($5,116)	0.8	($1,523)	>1	$6,255
CZ14	SDGE	1.6	-2,301	159	0.6	($755)	($17,159)	($5,149)	($5,130)	0.3	($12,028)	>1	$6,284
CZ15	SCE/SCG	1.6	-944	53	0.2	($164)	($3,077)	($5,407)	($5,369)	1.7	$2,291	14.3	$6,057
CZ16	PG&E	6.0	-4,314	404	1.5	($548)	($6,749)	($3,257)	($2,954)	0.4	($3,795)	>1	$4,685

Table 17. ADU Cost-Effectiveness: All-Electric Code Minimum

Climate Zone	Electric /Gas Utility	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	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	-1,832	114	0.4	($350)	($6,898)	($3,260)	($2,957)	0.4	($3,941)	1.4	$890
CZ02	PGE	0.4	-1,380	75	0.2	($356)	($7,647)	($3,260)	($2,957)	0.4	($4,690)	1.4	$803
CZ03	PGE	0.0	-1,665	123	0.5	($371)	($7,396)	($2,457)	($2,106)	0.3	($5,289)	2.3	$1,190
CZ04	PGE	0.2	-1,591	118	0.5	($355)	($7,077)	($3,260)	($2,957)	0.4	($4,120)	18.4	$2,796
CZ04	CPAU	0.2	-1,591	118	0.5	$42	$3,285	($3,260)	($2,957)	>1	$6,242	18.4	$2,796
CZ05	PGE	0.4	-1,031	49	0.1	($271)	($6,073)	($3,260)	($2,957)	0.5	($3,116)	1.4	$861
CZ05	PGE/SCG	0.4	-1,031	49	0.1	($226)	($4,656)	($3,260)	($2,957)	0.6	($1,699)	1.4	$861
CZ06	SCE/SCG	0.2	-909	38	0.1	($215)	($4,435)	($3,260)	($2,957)	0.7	($1,478)	1.6	$1,067
CZ07	SDGE	0.4	-879	37	0.1	($359)	($8,730)	($3,260)	($2,957)	0.3	($5,773)	1.7	$1,172
CZ08	SCE/SCG	0.6	-864	36	0.1	($212)	($4,397)	($3,216)	($2,908)	0.7	($1,489)	1.8	$1,271
CZ09	SCE	0.6	-901	38	0.1	($190)	($3,861)	($3,216)	($2,908)	0.8	($953)	1.8	$1,291
CZ10	SCE/SCG	0.4	-962	43	0.1	($184)	($3,663)	($3,216)	($2,908)	0.8	($755)	2.0	$1,450
CZ10	SDGE	0.4	-962	43	0.1	($379)	($9,153)	($3,216)	($2,908)	0.3	($6,245)	2.0	$1,450
CZ11	PGE	0.2	-1,322	71	0.2	($300)	($6,388)	($3,260)	($2,957)	0.5	($3,431)	1.7	$1,243
CZ12	PGE	0.3	-1,283	69	0.2	($302)	($6,461)	($3,260)	($2,957)	0.5	($3,504)	1.6	$1,117
CZ12	SMUD/PGE	0.3	-1,283	69	0.2	($78)	($1,161)	($3,260)	($2,957)	2.5	$1,796	1.6	$1,117
CZ13	PGE	0.1	-1,594	112	0.4	($300)	($5,856)	($3,260)	($2,957)	0.5	($2,898)	13.1	$2,731
CZ14	SCE/SCG	0.4	-1,658	115	0.4	($279)	($5,043)	($3,216)	($2,908)	0.6	($2,135)	14.5	$2,708
CZ14	SDGE	0.4	-1,658	115	0.4	($430)	($9,496)	($3,216)	($2,908)	0.3	($6,588)	14.5	$2,708
CZ15	SCE/SCG	1.3	-783	36	0.1	($146)	($2,872)	($3,216)	($2,908)	1.0	$35	2.6	$1,803
CZ16	PG&E	0.1	-1,807	122	0.4	($352)	($6,806)	($2,640)	($2,261)	0.3	($4,545)	1.2	$346

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

Table 18 and Table 19 compare cost-effectiveness results for the all-electric packages for the single family and ADU prototypes, respectively. In all cases the packages are cost effective based on TDV with the exception of the ADU efficiency + PV + battery package in Climate Zones 1 5, 7, and. On-Bill cost effectiveness generally improves with the addition of efficiency measures, improves significantly with an upsized PV system, and then declines again once batteries are added.

Table 18. Single Family Cost-Effectiveness: All-Electric Energy Efficiency + Additional PV + Battery

Climate Zone	Electric /Gas Utility	All Electric Efficiency				All Electric Efficiency + NEEA				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	0.8	($795)	>1	$9,843	3.7	$2,412	>1	$12,182	2.8	$22,687	1.8	$9,321	1.5	$11,427	1.3	$7,900
CZ02	PGE	0.7	($1,587)	>1	$9,303	1.1	$241	>1	$10,646	3.7	$16,422	3.3	$11,254	1.3	$5,119	1.8	$13,330
CZ03	PGE	0.6	($2,372)	>1	$6,595	0.8	($716)	>1	$7,909	4.1	$11,910	4.1	$8,257	1.0	$642	1.7	$9,207
CZ04	PGE	0.6	($2,168)	>1	$7,034	0.8	($984)	>1	$7,891	4.2	$10,338	5.4	$9,299	0.9	($830)	1.8	$10,513
CZ04	CPAU	>1	$7,938	>1	$7,034	>1	$13,440	>1	$7,891	>1	$13,961	>1	$12,968	1.4	$4,084	1.8	$10,513
CZ05	PGE	0.7	($2,083)	20.0	$5,140	1.2	$570	>1	$7,204	10.0	$12,997	28.9	$8,353	1.2	$2,016	1.8	$9,353
CZ05	PGE/SCG	0.7	($2,073)	20.0	$5,140	1.2	$580	>1	$7,204	10.0	$13,008	28.9	$8,353	1.2	$2,027	1.8	$9,353
CZ06	SCE/SCG	1.0	$52	35.5	$4,725	1.3	$868	>1	$5,487	63.5	$8,141	>1	$7,710	1.1	$906	1.9	$9,080
CZ07	SDGE	0.5	($3,874)	9.7	$4,940	0.6	($2,684)	>1	$5,681	70.1	$12,658	>1	$6,596	1.1	$1,174	1.7	$6,954
CZ08	SCE/SCG	1.1	$466	13.5	$4,802	1.4	$1,140	>1	$5,379	5.8	$5,873	76.6	$6,311	1.0	($614)	1.7	$7,953
CZ09	SCE	1.1	$337	156.1	$5,153	1.4	$1,072	>1	$5,834	8.8	$7,087	>1	$7,284	1.1	$661	2.0	$10,796
CZ10	SCE/SCG	1.0	($35)	>1	$5,253	1.3	$780	>1	$6,003	3.8	$6,627	6.3	$6,598	1.1	$837	1.5	$7,004
CZ10	SDGE	0.3	($7,962)	>1	$5,253	0.4	($6,727)	>1	$6,003	6.1	$12,102	6.3	$6,598	1.0	$553	1.5	$7,004
CZ11	PGE	1.3	$660	>1	$8,457	2.7	$1,993	>1	$9,534	2.4	$12,053	1.9	$6,541	1.1	$1,219	1.4	$8,097
CZ12	PGE	0.8	($603)	>1	$7,434	1.4	$845	>1	$8,596	3.4	$13,753	2.9	$8,617	1.1	$2,586	1.7	$10,595
CZ12	SMUD/PGE	>1	$8,905	>1	$7,434	>1	$9,450	>1	$8,596	2.9	$11,006	2.9	$8,617	1.0	$721	1.7	$10,595
CZ13	PGE	1.6	$1,218	>1	$8,079	4.4	$2,336	>1	$8,968	2.2	$9,312	1.9	$5,584	0.9	($1,214)	1.5	$8,278
CZ14	SCE/SCG	1.7	$1,062	>1	$7,791	>1	$2,493	>1	$8,910	3.2	$11,454	3.6	$10,615	1.4	$6,788	1.8	$12,197
CZ14	SDGE	0.3	($7,455)	>1	$7,791	0.4	($4,259)	>1	$8,939	4.5	$17,926	3.7	$10,644	1.4	$6,384	1.8	$12,227
CZ15	SCE/SCG	3.7	$2,354	>1	$5,891	11.1	$2,852	>1	$6,310	>1	$6,151	>1	$7,068	1.3	$2,751	1.8	$7,882
CZ16	PG&E	0.4	($2,384)	>1	$5,207	0.6	($1,286)	>1	$5,774	3.1	$22,096	1.9	$8,350	1.5	$10,795	1.5	$10,746

Table 19. ADU Cost-Effectiveness: All-Electric Energy Efficiency + Additional PV + Battery

Climate Zone	Electric /Gas Utility	All Electric Efficiency Only				All Electric Efficiency + NEEA				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	0.4	($3,941)	1.4	$890	2.7	$845	>1	$3,824	2.3	$17,261	1.1	$1,894	1.2	$5,689	0.9	($1,893)
CZ02	PGE	0.4	($4,690)	1.4	$803	0.4	($2,461)	>1	$2,065	2.6	$15,620	1.4	$4,069	1.2	$4,194	1.2	$4,912
CZ03	PGE	0.3	($5,289)	2.3	$1,190	0.2	($4,215)	>1	$1,734	2.5	$13,434	1.4	$3,614	1.1	$2,066	1.2	$3,115
CZ04	PGE	0.4	($4,120)	18.4	$2,796	0.1	($4,705)	>1	$2,151	2.4	$13,484	1.6	$5,521	1.1	$2,201	1.3	$5,349
CZ04	CPAU	>1	$6,242	18.4	$2,796	>1	$4,851	>1	$2,151	1.8	$7,248	1.6	$5,521	0.8	($4,463)	1.3	$5,349
CZ05	PGE	0.5	($3,116)	1.4	$861	0.4	($2,677)	2.1	$934	3.1	$15,641	1.5	$3,558	1.2	$4,306	1.1	$2,140
CZ05	PGE/SCG	0.6	($1,699)	1.4	$861	0.6	($1,260)	2.1	$934	3.3	$17,058	1.5	$3,558	1.3	$5,723	1.1	$2,140
CZ06	SCE/SCG	0.7	($1,478)	1.6	$1,067	0.6	($1,330)	2.8	$1,155	2.8	$12,451	1.7	$4,986	1.1	$2,645	1.3	$4,723
CZ07	SDGE	0.3	($5,773)	1.7	$1,172	0.3	($4,838)	2.8	$1,147	4.2	$23,903	1.5	$3,998	1.6	$12,313	1.1	$2,607
CZ08	SCE/SCG	0.7	($1,489)	1.8	$1,271	0.5	($1,490)	2.4	$1,045	2.7	$12,957	1.8	$6,189	1.2	$3,502	1.3	$6,462
CZ09	SCE	0.8	($953)	1.8	$1,291	0.7	($912)	2.5	$1,079	2.8	$13,210	1.8	$5,993	1.2	$3,743	1.4	$8,089
CZ10	SCE/SCG	0.8	($755)	2.0	$1,450	0.8	($458)	8.3	$1,533	3.7	$3,941	2.7	$2,584	0.6	($5,224)	1.1	$1,569
CZ10	SDGE	0.3	($6,245)	2.0	$1,450	0.2	($5,255)	8.3	$1,533	4.8	$5,573	2.7	$2,584	0.5	($6,077)	1.1	$1,569
CZ11	PGE	0.5	($3,431)	1.7	$1,243	0.5	($1,399)	>1	$2,557	2.4	$4,214	2.0	$2,821	0.5	($7,012)	1.2	$3,307
CZ12	PGE	0.5	($3,504)	1.6	$1,117	0.4	($2,363)	>1	$1,976	2.8	$16,498	1.5	$4,450	1.2	$5,204	1.2	$5,174
CZ12	SMUD/PGE	2.5	$1,796	1.6	$1,117	>1	$1,311	>1	$1,976	1.5	$4,802	1.5	$4,450	0.7	($5,891)	1.2	$5,174
CZ13	PGE	0.5	($2,898)	13.1	$2,731	0.1	($2,220)	>1	$2,892	1.9	$2,908	2.0	$3,303	0.4	($8,250)	1.3	$4,990
CZ14	SCE/SCG	0.6	($2,135)	14.5	$2,708	0.0	($1,864)	>1	$2,531	2.5	$14,319	1.8	$8,119	1.3	$5,615	1.4	$8,380
CZ14	SDGE	0.3	($6,588)	14.5	$2,708	0.0	($4,744)	>1	$2,531	4.1	$29,863	1.8	$8,119	1.9	$18,220	1.4	$8,380
CZ15	SCE/SCG	1.0	$35	2.6	$1,803	1.7	$546	>1	$1,920	6.0	$3,666	5.0	$2,923	0.6	($4,520)	1.2	$3,022
CZ16	PG&E	0.3	($4,545)	1.2	$346	0.4	($2,423)	>1	$2,260	3.0	$19,644	1.6	$5,523	1.4	$8,259	1.3	$5,676

4.4 Mixed Fuel Results

Table 20 and Table 21 show results for the Mixed Fuel Efficiency + PV + Battery package compared to the 2022 baseline for Single Family and ADU, respectively. This package for single family homes is cost-effective based on TDV everywhere except in Climate Zone 7, although the cost-effectiveness is marginal in many of the climate zones. The package is not cost-effective On-Bill anywhere. For the ADU the package is cost-effective based on one of the two metrics in Climate Zones 1, 2, 7 through 9, 12, 14, and 16. For the climate zones where there is no PV requirement in the base package, the addition of a new PV system substantially reduced utility costs and the high cost-effectiveness of this measure helped to offset the high cost of the battery system.

Table 20. Single Family Cost-Effectiveness: Mixed Fuel Efficiency + PV + Battery

Climate Zone	Electric /Gas Utility	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	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	30.0	1,577	118	1.1	$710	$18,829	$9,595	$16,912	1.1	$1,917	1.3	$4,260
CZ02	PGE	13.5	1,264	35	0.7	$419	$10,499	$8,701	$15,618	0.7	($5,119)	1.3	$5,173
CZ03	PGE	11.2	1,073	7	0.6	$334	$8,001	$7,288	$13,851	0.6	($5,850)	1.2	$2,130
CZ04	PGE	8.4	912	6	0.5	$269	$6,471	$7,806	$14,483	0.4	($8,011)	1.1	$2,138
CZ04	CPAU	8.4	912	6	0.5	$159	$3,839	$7,806	$14,483	0.3	($10,644)	1.1	$2,138
CZ05	PGE	16.8	1,186	43	0.8	$416	$10,571	$7,304	$13,830	0.8	($3,259)	1.3	$4,264
CZ05	PGE/SCG	16.8	1,186	43	0.8	$394	$9,850	$8,088	$14,879	0.7	($5,030)	1.2	$3,215
CZ06	SCE/SCG	9.2	894	6	0.5	$370	$8,721	$6,956	$13,346	0.7	($4,625)	1.2	$3,208
CZ07	SDGE	8.3	841	4	0.5	$358	$9,129	$7,421	$13,987	0.7	($4,857)	1.1	$981
CZ08	SCE/SCG	9.5	783	2	0.5	$381	$8,924	$7,852	$14,606	0.6	($5,682)	1.1	$2,181
CZ09	SCE	8.6	839	3	0.5	$390	$9,148	$7,443	$14,059	0.7	($4,911)	1.3	$4,668
CZ10	SCE/SCG	8.3	854	2	0.5	$416	$9,733	$7,659	$14,474	0.7	($4,740)	1.1	$878
CZ10	SDGE	8.3	854	2	0.5	$314	$7,983	$7,659	$14,474	0.6	($6,491)	1.1	$878
CZ11	PGE	11.0	1,034	27	0.7	$398	$9,903	$10,972	$18,674	0.5	($8,771)	1.0	$703
CZ12	PGE	11.0	1,107	23	0.6	$364	$9,006	$9,071	$16,132	0.6	($7,126)	1.2	$3,110
CZ12	SMUD/PGE	11.0	1,107	23	0.6	$252	$6,354	$9,071	$16,132	0.4	($9,778)	1.2	$3,110
CZ13	PGE	9.6	1,168	5	0.6	$455	$10,863	$11,684	$19,564	0.6	($8,701)	1.0	$95
CZ14	SCE/SCG	11.2	1,737	6	0.7	$704	$16,522	$10,115	$17,352	1.0	($830)	1.2	$3,200
CZ14	SDGE	11.2	1,737	6	0.7	$537	$13,684	$9,414	$16,415	0.8	($2,731)	1.3	$4,138
CZ15	SCE/SCG	8.5	532	2	0.5	$486	$11,372	$6,920	$13,256	0.9	($1,883)	1.2	$2,549
CZ16	PG&E	22.6	1,235	115	1.2	$571	$15,439	$10,530	$17,726	0.9	($2,287)	1.4	$6,563

Table 21. ADU Cost-Effectiveness: Mixed Fuel Efficiency + PV + Battery

Climate Zone	Electric /Gas Utility	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	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	24.3	3,642	79	0.8	$1,211	$29,946	$15,209	$25,106	1.2	$4,840	0.9	($3,490)
CZ02	PGE	14.5	3,451	40	0.6	$1,028	$25,019	$12,944	$22,077	1.1	$2,942	1.1	$3,210
CZ03	PGE	12.1	2,750	2	0.4	$730	$17,326	$11,077	$18,815	0.9	($1,488)	1.0	($36)
CZ04	PGE	12.2	2,860	2	0.4	$759	$17,992	$11,523	$19,326	0.9	($1,335)	1.1	$976
CZ04	CPAU	12.2	2,860	2	0.4	$316	$7,490	$11,523	$19,326	0.4	($11,836)	1.1	$976
CZ05	PGE	7.8	3,293	14	0.5	$959	$22,944	$11,409	$20,110	1.1	$2,834	1.0	($70)
CZ05	PGE/SCG	7.8	3,293	14	0.5	$952	$22,711	$11,409	$20,110	1.1	$2,601	1.0	($70)
CZ06	SCE/SCG	9.8	3,292	3	0.5	$815	$19,093	$11,028	$19,600	1.0	($507)	1.1	$2,238
CZ07	SDGE	9.1	3,306	1	0.5	$1,172	$29,683	$11,381	$20,073	1.5	$9,610	1.0	$128
CZ08	SCE/SCG	10.1	3,527	1	0.5	$887	$20,746	$11,594	$20,356	1.0	$389	1.2	$3,479
CZ09	SCE	8.9	3,512	3	0.5	$883	$20,676	$11,361	$20,046	1.0	$630	1.3	$5,211
CZ10	SCE/SCG	9.0	729	7	0.4	$244	$5,806	$7,005	$14,209	0.4	($8,404)	0.9	($1,176)
CZ10	SDGE	9.0	729	7	0.4	$206	$5,312	$7,005	$14,209	0.4	($8,897)	0.9	($1,176)
CZ11	PGE	13.1	870	36	0.5	$277	$7,182	$8,022	$15,484	0.5	($8,302)	1.1	$1,331
CZ12	PGE	12.6	3,589	33	0.6	$1,063	$25,738	$12,806	$21,883	1.2	$3,856	1.1	$3,071
CZ12	SMUD/PGE	12.6	3,589	33	0.6	$591	$14,577	$12,806	$21,883	0.7	($7,306)	1.1	$3,071
CZ13	PGE	12.8	359	1	0.4	$77	$1,846	$7,009	$13,279	0.1	($11,433)	1.1	$1,422
CZ14	SCE/SCG	14.2	3,624	2	0.5	$912	$21,326	$12,054	$19,956	1.1	$1,370	1.2	$3,029
CZ14	SDGE	14.2	3,624	2	0.5	$1,292	$32,729	$12,054	$19,956	1.6	$12,773	1.2	$3,029
CZ15	SCE/SCG	11.2	546	0	0.4	$252	$5,891	$6,588	$13,566	0.4	($7,675)	1.0	$355
CZ16	PG&E	16.2	3,652	87	0.8	$1,178	$29,323	$13,234	$22,496	1.3	$6,827	1.1	$3,151

Table 22 and Table 23 compare cost-effectiveness results across all the mixed fuel packages for the single family and ADU prototypes, respectively. The single family Efficiency Only package and Efficiency + PV package are cost effective based on On-Bill and TDV under most scenarios. The trends are similar for the ADU except the Efficiency Only package is not cost effective in many climate zones.

Table 22. Single Family Cost-Effectiveness: Mixed Fuel Packages

Climate Zone	Electric /Gas Utility	Mixed Fuel Efficiency Only				Mixed Fuel Efficiency + PV				Mixed Fuel Efficiency + PV + Battery			
		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	3.2	$3,900	2.8	$3,218	2.5	$9,260	1.5	$2,984	1.1	$1,917	1.3	$4,260
CZ02	PGE	2.3	$2,220	2.6	$2,727	2.3	$5,889	1.7	$3,254	0.7	($5,119)	1.3	$5,173
CZ03	PGE	1.5	$841	1.1	$185	2.1	$4,099	1.2	$573	0.6	($5,850)	1.2	$2,130
CZ04	PGE	1.0	$85	1.1	$134	1.6	$2,383	1.2	$660	0.4	($8,011)	1.1	$2,138
CZ04	CPAU	0.6	($879)	1.1	$134	0.8	($629)	1.2	$660	0.3	($10,644)	1.1	$2,138
CZ05	PGE	2.2	$998	1.8	$638	3.5	$5,980	2.0	$2,409	0.8	($3,259)	1.3	$4,264
CZ05	PGE/SCG	1.9	$785	1.8	$638	3.5	$5,767	2.0	$2,409	0.7	($5,030)	1.2	$3,215
CZ06	SCE/SCG	0.8	($214)	1.1	$98	2.5	$3,384	1.8	$1,745	0.7	($4,625)	1.2	$3,208
CZ07	SDGE	2.2	$877	1.4	$313	3.8	$6,703	1.4	$1,032	0.7	($4,857)	1.1	$981
CZ08	SCE/SCG	1.0	$42	1.2	$237	1.4	$1,481	1.1	$203	0.6	($5,682)	1.1	$2,181
CZ09	SCE	1.1	$133	1.4	$384	1.8	$2,301	1.3	$900	0.7	($4,911)	1.3	$4,668
CZ10	SCE/SCG	1.2	$285	1.3	$379	1.4	$1,573	1.0	$16	0.7	($4,740)	1.1	$878
CZ10	SDGE	2.0	$1,241	1.3	$379	2.1	$4,260	1.0	$16	0.6	($6,491)	1.1	$878
CZ11	PGE	2.3	$2,522	2.2	$2,231	1.2	$1,754	0.9	($1,054)	0.5	($8,771)	1.0	$703
CZ12	PGE	1.6	$1,229	1.6	$1,251	1.7	$3,644	1.2	$993	0.6	($7,126)	1.2	$3,110
CZ12	SMUD/PGE	1.2	$411	1.6	$1,251	1.1	$427	1.2	$993	0.4	($9,778)	1.2	$3,110
CZ13	PGE	1.8	$1,820	1.5	$1,169	1.1	$1,058	0.7	($2,714)	0.6	($8,701)	1.0	$95
CZ14	SCE/SCG	1.6	$1,792	1.4	$1,233	1.8	$5,077	1.3	$1,567	1.0	($830)	1.2	$3,200
CZ14	SDGE	2.6	$4,611	1.4	$1,233	2.2	$7,489	1.3	$1,567	0.8	($2,731)	1.3	$4,138
CZ15	SCE/SCG	1.9	$1,814	1.8	$1,488	2.0	$1,934	1.7	$1,497	0.9	($1,883)	1.2	$2,549
CZ16	PG&E	2.0	$3,404	2.1	$3,993	2.3	$8,604	1.7	$4,865	0.9	($2,287)	1.4	$6,563

Table 23. ADU Cost-Effectiveness: Mixed Fuel Packages

Climate Zone	Electric /Gas Utility	Mixed Fuel Efficiency				Mixed Fuel Efficiency + PV				Mixed Fuel Efficiency + PV + Battery			
		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	0.6	($570)	1.7	$1,046	2.2	$16,496	1.1	$906	1.2	$4,840	0.9	($3,490)
CZ02	PGE	0.5	($681)	1.4	$578	2.4	$14,445	1.3	$2,743	1.1	$2,942	1.1	$3,210
CZ03	PGE	1.1	$70	0.9	($81)	2.4	$9,933	1.2	$1,437	0.9	($1,488)	1.0	($36)
CZ04	PGE	0.7	($430)	0.9	($170)	2.3	$9,997	1.3	$2,204	0.9	($1,335)	1.1	$976
CZ04	CPAU	0.3	($997)	0.9	($170)	1.1	$395	1.3	$2,204	0.4	($11,836)	1.1	$976
CZ05	PGE	0.0	($1,012)	0.3	($662)	2.7	$14,272	1.2	$1,965	1.1	$2,834	1.0	($70)
CZ05	PGE/SCG	0.0	($1,245)	0.3	($662)	2.6	$14,039	1.2	$1,965	1.1	$2,601	1.0	($70)
CZ06	SCE/SCG	0.5	($447)	0.8	($159)	2.2	$9,792	1.4	$3,036	1.0	($507)	1.1	$2,238
CZ07	SDGE	1.1	$136	0.8	($237)	3.5	$21,226	1.3	$2,175	1.5	$9,610	1.0	$128
CZ08	SCE/SCG	0.6	($405)	0.7	($340)	2.2	$10,545	1.4	$3,880	1.0	$389	1.2	$3,479
CZ09	SCE	0.5	($513)	0.7	($301)	2.3	$10,753	1.4	$3,699	1.0	$630	1.3	$5,211
CZ10	SCE/SCG	0.5	($493)	0.7	($277)	1.6	$1,628	1.1	$345	0.4	($8,404)	0.9	($1,176)
CZ10	SDGE	1.8	$871	0.7	($277)	2.1	$2,740	1.1	$345	0.4	($8,897)	0.9	($1,176)
CZ11	PGE	1.3	$500	1.5	$740	1.8	$2,984	1.3	$1,183	0.5	($8,302)	1.1	$1,331
CZ12	PGE	0.6	($669)	1.1	$200	2.5	$15,215	1.3	$2,729	1.2	$3,856	1.1	$3,071
CZ12	SMUD/PGE	1.3	$441	1.1	$200	1.3	$3,485	1.3	$2,729	0.7	($7,306)	1.1	$3,071
CZ13	PGE	0.8	($339)	1.3	$546	0.8	($296)	1.3	$568	0.1	($11,433)	1.1	$1,422
CZ14	SCE/SCG	1.3	$595	1.2	$407	2.4	$11,437	1.5	$4,433	1.1	$1,370	1.2	$3,029
CZ14	SDGE	1.9	$1,821	1.2	$407	3.9	$24,351	1.5	$4,433	1.6	$12,773	1.2	$3,029
CZ15	SCE/SCG	1.6	$922	1.4	$629	1.8	$1,427	1.4	$767	0.4	($7,675)	1.0	$355
CZ16	PG&E	0.3	($845)	1.4	$500	2.7	$18,290	1.3	$3,687	1.3	$6,827	1.1	$3,151

4.5 CARE Rate Comparison

Table 24 and Table 25 present a comparison of On-Bill cost-effectiveness results for CARE tariffs relative to standard tariffs. The all-electric code minimum package for the single family and ADU prototypes is shown in Table 24. Applying the CARE rates lowers both electric and gas utility bills for the consumer and the net impact is lower overall bills for an all-electric home and improved cost-effectiveness relative to the standard tariffs. The opposite trend occurs for the mixed fuel packages shown in Table 25 where the CARE rate lower utility cost savings and the benefit-to-cost ratios decline.

Table 24. 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	0.5	($5,721)	0.8	($1,105)	0.4	($3,941)	0.6	($1,612)
CZ02	PGE	0.5	($4,933)	0.8	($1,389)	0.4	($4,690)	0.6	($2,253)
CZ03	PGE	0.6	($4,017)	0.9	($427)	0.3	($5,289)	0.4	($2,594)
CZ04	PGE	0.6	($3,138)	1.0	$75	0.4	($4,120)	0.7	($1,573)
CZ04	CPAU	>1	$13,205	>1	$9,931	>1	$6,242	>1	$2,957
CZ05	PGE	0.6	($3,803)	0.9	($755)	0.5	($3,116)	0.7	($1,266)
CZ05	PGE/SCG	0.6	($3,793)	1.1	$444	0.6	($1,699)	1.1	$243
CZ06	SCE/SCG	1.0	$115	1.6	$1,984	0.7	($1,478)	1.0	($98)
CZ07	SDGE	0.5	($4,872)	0.9	($838)	0.3	($5,773)	0.5	($2,643)
CZ08	SCE/SCG	1.1	$371	1.7	$2,073	0.7	($1,489)	1.0	($139)
CZ09	SCE	1.0	$126	1.6	$2,001	0.8	($953)	1.1	$261
CZ10	SCE/SCG	0.9	($486)	1.5	$1,703	0.8	($755)	1.2	$433
CZ10	SDGE	0.4	($9,442)	0.6	($3,532)	0.3	($6,245)	0.5	($2,847)
CZ11	PGE	0.7	($1,979)	1.1	$461	0.5	($3,431)	0.7	($1,451)
CZ12	PGE	0.7	($2,086)	1.1	$350	0.5	($3,504)	0.7	($1,502)
CZ12	SMUD/PGE	>1	$9,653	>1	$12,533	2.5	$1,796	>1	$4,174
CZ13	PGE	0.8	($1,001)	1.4	$1,409	0.5	($2,898)	0.7	($1,098)
CZ14	SCE/SCG	0.8	($1,523)	1.3	$1,186	0.6	($2,135)	0.9	($176)
CZ14	SDGE	0.3	($12,028)	0.5	($4,758)	0.3	($6,588)	0.5	($2,452)
CZ15	SCE/SCG	1.7	$2,291	2.6	$3,334	1.0	$35	1.5	$927
CZ16	PG&E	0.4	($3,795)	0.8	($932)	0.3	($4,545)	0.5	($2,264)

Table 25. 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	1.1	$1,917	0.7	($4,294)	1.2	$4,840	0.8	($6,038)
CZ02	PGE	0.7	($5,119)	0.4	($8,677)	1.1	$2,942	0.7	($6,218)
CZ03	PGE	0.6	($5,850)	0.4	($8,437)	0.9	($1,488)	0.6	($7,714)
CZ04	PGE	0.4	($8,011)	0.3	($10,029)	0.9	($1,335)	0.6	($7,819)
CZ04	CPAU	0.3	($10,644)	0.0	($14,483)	0.4	($11,836)	0.0	($19,326)
CZ05	PGE	0.8	($3,259)	0.5	($6,846)	1.1	$2,834	0.7	($5,519)
CZ05	PGE/SCG	0.7	($5,030)	0.5	($8,058)	1.1	$2,601	0.7	($5,556)
CZ06	SCE/SCG	0.7	($4,625)	0.4	($8,204)	1.0	($507)	0.6	($7,693)
CZ07	SDGE	0.7	($4,857)	0.5	($6,954)	1.5	$9,610	1.0	($326)
CZ08	SCE/SCG	0.6	($5,682)	0.4	($9,307)	1.0	$389	0.6	($7,342)
CZ09	SCE	0.7	($4,911)	0.4	($8,607)	1.0	$630	0.6	($7,069)
CZ10	SCE/SCG	0.7	($4,740)	0.4	($8,612)	0.4	($8,404)	0.2	($11,077)
CZ10	SDGE	0.6	($6,491)	0.4	($8,146)	0.4	($8,897)	0.3	($9,877)
CZ11	PGE	0.5	($8,771)	0.4	($12,059)	0.5	($8,302)	0.3	($10,635)
CZ12	PGE	0.6	($7,126)	0.4	($10,123)	1.2	$3,856	0.7	($5,583)
CZ12	SMUD/PGE	0.4	($9,778)	0.1	($15,142)	0.7	($7,306)	0.1	($20,478)
CZ13	PGE	0.6	($8,701)	0.4	($12,454)	0.1	($11,433)	0.1	($11,991)
CZ14	SCE/SCG	1.0	($830)	0.6	($6,866)	1.1	$1,370	0.7	($6,543)
CZ14	SDGE	0.8	($2,731)	0.6	($6,354)	1.6	$12,773	1.1	$1,781
CZ15	SCE/SCG	0.9	($1,883)	0.5	($6,103)	0.4	($7,675)	0.2	($10,336)
CZ16	PG&E	0.9	($2,287)	0.6	($7,467)	1.3	$6,827	0.8	($3,846)

4.6 Utility Infrastructure Cost Sensitivity

Table 26 compares cost effectiveness results for the three natural gas infrastructure cost scenarios presented in **Error! Reference source not found.**. The average cost scenario reflects the costs applied in the results presented in the prior sections (Table 16 and Table 18). The gas infrastructure cost savings are lower for the new subdivision case and higher for the infill development case. For the latter, the all-electric home is On-Bill cost-effective in all climate zones except Climate Zones 1, 10 in SDG&E territory, and 14 in SDG&E territory.

Table 26. 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	0.5	($5,721)	>1	$7,362	0.4	($6,945)	>1	$6,138	0.9	($825)	>1	$12,257
CZ02	PGE	0.5	($4,933)	>1	$7,185	0.4	($6,157)	>1	$5,961	1.0	($37)	>1	$12,081
CZ03	PGE	0.6	($4,017)	88.7	$6,191	0.4	($5,241)	71.4	$4,967	1.1	$879	158.1	$11,086
CZ04	PGE	0.6	($3,138)	>1	$6,705	0.5	($4,362)	>1	$5,481	1.2	$1,757	>1	$11,601
CZ04	CPAU	>1	$13,205	>1	$6,705	>1	$13,205	>1	$5,481	>1	$13,205	>1	$11,601
CZ05	PGE	0.6	($3,803)	3.5	$4,571	0.4	($5,027)	2.9	$3,348	1.1	$1,093	6.2	$9,467
CZ05	PGE/SCG	0.6	($3,793)	3.5	$4,571	0.4	($5,017)	2.9	$3,348	1.1	$1,103	6.2	$9,467
CZ06	SCE/SCG	1.0	$115	4.4	$4,937	0.8	($1,109)	3.6	$3,713	2.0	$5,011	7.8	$9,833
CZ07	SDGE	0.5	($4,872)	4.2	$4,877	0.4	($6,096)	3.4	$3,653	1.0	$24	7.5	$9,773
CZ08	SCE/SCG	1.1	$371	3.9	$4,746	0.8	($853)	3.2	$3,522	2.1	$5,266	6.9	$9,642
CZ09	SCE	1.0	$126	4.5	$4,974	0.8	($1,098)	3.7	$3,750	2.0	$5,022	8.0	$9,870
CZ10	SCE/SCG	0.9	($486)	4.9	$5,080	0.7	($1,710)	4.0	$3,856	1.8	$4,410	8.7	$9,976
CZ10	SDGE	0.4	($9,442)	4.9	$5,080	0.3	($10,666)	4.0	$3,856	0.7	($4,546)	8.7	$9,976
CZ11	PGE	0.7	($1,979)	>1	$6,930	0.6	($3,203)	>1	$5,706	1.4	$2,917	>1	$11,826
CZ12	PGE	0.7	($2,086)	>1	$6,797	0.5	($3,310)	>1	$5,573	1.4	$2,809	>1	$11,693
CZ12	SMUD/PGE	>1	$9,653	>1	$6,797	>1	$8,429	>1	$5,573	>1	$14,549	>1	$11,693
CZ13	PGE	0.8	($1,001)	>1	$6,680	0.6	($2,225)	>1	$5,457	1.6	$3,895	>1	$11,576
CZ14	SCE/SCG	0.8	($1,523)	>1	$6,255	0.6	($2,747)	>1	$5,031	1.5	$3,373	>1	$11,151
CZ14	SDGE	0.3	($12,028)	>1	$6,284	0.2	($13,252)	>1	$5,060	0.6	($7,133)	>1	$11,180
CZ15	SCE/SCG	1.7	$2,291	14.3	$6,057	1.3	$1,067	11.6	$4,833	3.3	$7,187	25.0	$10,953
CZ16	PG&E	0.4	($3,795)	>1	$4,685	0.3	($5,019)	>1	$3,461	1.2	$1,101	>1	$9,581

Table 27. Single Family Cost-Effectiveness On-Bill Impact of CPUC Proposed Design on Gas Line Extension Allowances: All-Electric Code Minimum

Climate Zone	Electric /Gas Utility	No Allowances			
		With Allowance		No Allowances	
		B/C Ratio	NPV	B/C Ratio	NPV
CZ01	PGE	0.5	($5,721)	0.6	($4,576)
CZ02	PGE	0.5	($4,933)	0.6	($3,788)
CZ03	PGE	0.6	($4,017)	0.7	($2,872)
CZ04	PGE	0.6	($3,138)	0.8	($1,993)
CZ04	CPAU	>1	$13,205	>1	$9,535
CZ05	PGE	0.6	($3,803)	0.7	($2,658)
CZ05	PGE/SCG	0.6	($3,793)	0.7	($2,647)
CZ06	SCE/SCG	1.0	$115	1.2	$1,260
CZ07	SDGE	0.5	($4,872)	0.6	($3,726)
CZ08	SCE/SCG	1.1	$371	1.3	$1,516
CZ09	SCE	1.0	$126	1.2	$1,271
CZ10	SCE/SCG	0.9	($486)	1.1	$660
CZ10	SDGE	0.4	($9,442)	0.4	($8,296)
CZ11	PGE	0.7	($1,979)	0.9	($834)
CZ12	PGE	0.7	($2,086)	0.9	($941)
CZ12	SMUD/PGE	>1	$9,653	>1	$10,799
CZ13	PGE	0.8	($1,001)	1.0	$145
CZ14	SCE/SCG	0.8	($1,523)	0.9	($392)
CZ14	SDGE	0.3	($12,028)	0.4	($10,883)
CZ15	SCE/SCG	1.7	$2,291	2.1	$3,437
CZ16	PG&E	0.4	($3,795)	0.6	($2,649)

4.7 Greenhouse Gas Reductions

Table 28 and Table 29 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 more greenhouse gas emissions in Climate Zones 1 through 4, 11, 12, and 16 than the mixed fuel Efficiency + PV + Battery package. 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, 13, and 14

Table 28: Single Family Greenhouse Gas Reductions (metric tons)

Climate Zone	Single Family All-Electric					Single Family Mixed Fuel		
	Code Minimum	Efficiency Only	Efficiency + NEEA	Efficiency + PV	Efficiency + PV + Battery	Efficiency Only	Efficiency + PV	Efficiency + PV + Battery
CZ01	1.5	1.6	1.7	1.8	2.2	0.4	0.5	1.1
CZ02	0.8	0.9	1.0	1.1	1.5	0.3	0.3	0.7
CZ03	0.7	0.8	0.8	0.8	1.3	0.1	0.1	0.6
CZ04	0.7	0.7	0.8	0.8	1.2	0.1	0.1	0.5
CZ05	0.4	0.4	0.5	0.5	1.0	0.1	0.1	0.8
CZ06	0.3	0.3	0.3	0.4	0.8	0.1	0.1	0.5
CZ07	0.2	0.2	0.3	0.3	0.7	0.0	0.1	0.5
CZ08	0.2	0.2	0.3	0.3	0.7	0.0	0.1	0.5
CZ09	0.3	0.3	0.3	0.3	0.8	0.0	0.1	0.5
CZ10	0.3	0.3	0.4	0.4	0.9	0.1	0.1	0.5
CZ11	0.8	0.9	0.9	0.9	1.4	0.2	0.2	0.7
CZ12	0.7	0.8	0.8	0.9	1.3	0.2	0.2	0.6
CZ13	0.6	0.7	0.7	0.8	1.2	0.1	0.1	0.6
CZ14	0.6	0.7	0.8	0.8	1.3	0.2	0.2	0.7
CZ15	0.2	0.2	0.2	0.2	0.7	0.1	0.1	0.5
CZ16	1.5	1.6	1.6	1.8	2.2	0.7	0.8	1.2

Table 29: ADU Greenhouse Gas Savings (metric tons)

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

5 Summary

The Reach Codes Team identified 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 30 (all-electric) and Table 31 (mixed fuel) summarize results for each prototype and depicts the efficiency EDR2 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 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.

Following are key takeaways and recommendations from the analysis.

- 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 Reach Codes Team found all-electric new construction to be feasible and cost effective based on TDV in all cases. In many cases all-electric code minimum 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.
- 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. 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 an all-electric reach code for single family buildings also include an efficiency requirement with EDR2 margins consistent with the all-electric code minimum package results in Table 30.
- The code compliance margins for the ADU all-electric code minimum package are lower than for the single family prototype and code compliance can be more challenging for smaller dwelling units. As a result, the Reach Codes Team does not recommend an additional efficiency requirement for all-electric ADU ordinances.
- Electrification combined with increased PV capacity results in utility cost savings and was found to be On-Bill cost effective in all cases. These results were based on today's net energy metering rules and do not account for future changes to utility agreements, which are expected to decrease the value of PV to the consumer.
- For jurisdictions interested in a reach code that allows for mixed fuel buildings the mixed fuel efficiency, PV, and battery package was found to be cost effective based on TDV only for single family buildings in all climate zones except Climate Zone 7. Cost effectiveness was marginal because of the high cost of the battery system. EDR2 margins ranged from 8 to 30 for the cost-effective packages as is shown in Table 31. The ADU mixed fuel efficiency + PV +battery package was only cost-effective in about half of the climate zones as shown in Table 20. The ADU mixed fuel efficiency + PV package was cost-effective everywhere.

- Applying the CARE rates has the overall impact to increase utility cost savings for an all-electric building compared to a code compliant mixed fuel building, improving On-Bill cost-effectiveness.

Table 30. Summary of All-Electric Efficiency EDR2 Margins and Cost-Effectiveness

Climate Zone	Electric /Gas Utility	Single Family					ADU		
		Code	EE	EE+PV	EE+PV/Batt	Code Min	EE	EE+PV	EE+PV/Batt
CZ01	PGE	8.3	18.8	18.9	29.7	0.0	15.1	15.1	24.6
CZ02	PGE	5.7	13.5	13.4	19.1	0.4	9.5	9.5	14.6
CZ03	PGE	4.7	10.5	10.7	15.9	0.0	5.7	5.7	10.5
CZ04	PGE	3.7	8.6	8.4	13.4	0.2	6.3	6.3	10.8
CZ04	CPAU	3.7	8.6	8.4	13.4	0.2	6.3	6.3	10.8
CZ05	PGE	1.1	6.1	6.1	14.4	0.4	2.4	2.4	7.9
CZ05	PGE/SCG	1.1	6.1	6.1	14.4	0.4	2.4	2.4	7.9
CZ06	SCE/SCG	2.5	7.8	7.8	11.6	0.2	6.2	6.2	9.8
CZ07	SDGE	2.3	7.0	7.1	10.0	0.4	6.3	6.3	9.1
CZ08	SCE/SCG	0.6	4.0	4.0	10.4	0.6	3.6	3.6	10.0
CZ09	SCE	1.2	4.6	4.6	9.9	0.6	3.7	3.7	8.8
CZ10	SCE/SCG	1.1	4.6	4.6	10.0	0.4	3.8	3.8	9.1
CZ10	SDGE	1.1	4.6	4.6	10.0	0.4	3.8	3.8	9.1
CZ11	PGE	3.5	8.4	8.3	14.0	0.2	7.7	7.7	13.2
CZ12	PGE	4.0	8.5	8.5	14.6	0.3	6.8	6.8	12.6
CZ12	SMUD/PGE	4.0	8.5	8.5	14.6	0.3	6.8	6.8	12.6
CZ13	PGE	2.1	6.8	6.8	11.9	0.1	6.8	6.8	11.9
CZ14	SCE/SCG	1.6	7.9	7.8	13.1	0.4	7.3	7.3	12.4
CZ14	SDGE	1.6	7.9	7.8	13.1	0.4	7.3	7.3	12.4
CZ15	SCE/SCG	1.6	4.2	4.2	8.6	1.3	6.5	6.5	11.1
CZ16	PG&E	6.0	9.7	9.1	17.4	0.1	8.8	8.8	16.4

Table 31. Summary of Mixed Fuel Efficiency EDR2 Margins and Cost-Effectiveness

Climate Zone	Electric /Gas Utility	Single Family			ADU		
		EE	EE+PV	EE+PV/Batt	EE	EE+PV	EE+PV/Batt
CZ01	PGE	12.0	12.0	30.0	14.9	14.9	24.3
CZ02	PGE	8.8	8.8	13.5	9.4	9.4	14.5
CZ03	PGE	5.7	5.7	11.2	6.3	6.3	12.1
CZ04	PGE	4.8	4.8	9.6	6.7	6.7	12.2
CZ04	CPAU	4.8	4.8	9.6	6.7	6.7	12.2
CZ05	PGE	4.8	4.8	16.8	2.3	2.3	7.8
CZ05	PGE/SCG	4.8	4.8	16.8	2.3	2.3	7.8
CZ06	SCE/SCG	6.1	6.1	9.2	6.1	6.1	9.8
CZ07	SDGE	5.5	5.5	6.2	6.3	6.3	9.1
CZ08	SCE/SCG	3.5	3.5	9.5	3.6	3.6	10.1
CZ09	SCE	3.6	3.6	8.6	3.7	3.7	8.9
CZ10	SCE/SCG	3.7	3.7	8.3	3.8	3.8	9.0
CZ10	SDGE	3.7	3.7	8.3	3.8	3.8	9.0
CZ11	PGE	5.7	5.7	11.0	7.5	7.5	13.1
CZ12	PGE	5.3	5.3	11.0	6.8	6.8	12.6
CZ12	SMUD/PGE	5.3	5.3	11.0	6.8	6.8	12.6
CZ13	PGE	4.7	4.7	9.6	7.2	7.2	12.8
CZ14	SCE/SCG	6.2	6.2	11.2	8.5	8.5	14.2
CZ14	SDGE	6.2	6.2	11.2	8.5	8.5	14.2
CZ15	SCE/SCG	4.3	4.3	8.5	6.6	6.6	11.2
CZ16	PG&E	14.9	14.9	22.6	8.7	8.7	16.2

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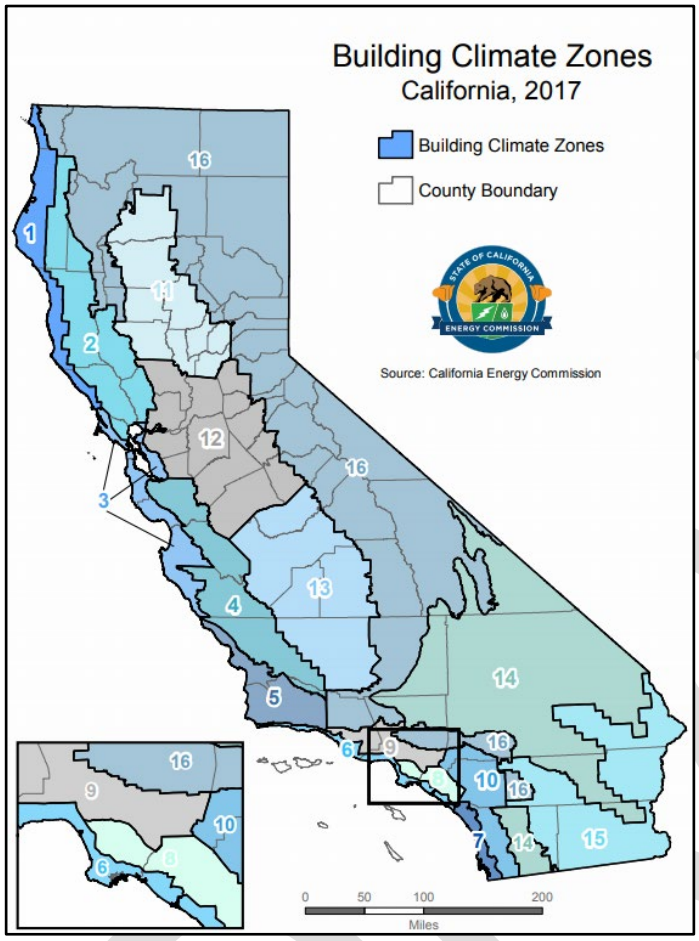
7 Appendices

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

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.

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 32 describes the baseline territories that were assumed for each climate zone.

Table 32: PG&E Baseline Territory by 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 for the 12-month period ending August 2021 according to the rates shown in Table 33. The corresponding CARE rates are shown in Table 34.

Table 33: PG&E Monthly Gas Rate ($/therm)

Month	Procurement Charge	Transportation Charge		Total Charge	
		Baseline	Excess	Baseline	Excess
Jan 2022	$0.76338	$1.33589	$1.79545	$2.09927	$2.55883
Feb 2022	$0.73412	$1.33589	$1.79545	$2.07001	$2.52957
Mar 2022	$0.61773	$1.33589	$1.79545	$1.95362	$2.41318
Apr 2021	$0.22304	$1.19868	$1.68034	$1.42172	$1.90338
May 2021	$0.21063	$1.19868	$1.68034	$1.40931	$1.89097
June 2021	$0.21778	$1.20019	$1.68243	$1.41797	$1.90021
July 2021	$0.19109	$1.20019	$1.68243	$1.39128	$1.87352
Aug 2021	$0.22551	$1.20019	$1.68243	$1.4257	$1.90794
Sept 2021	$0.44379	$1.20019	$1.68243	$1.64398	$2.12622
Oct 2021	$0.68120	$1.20019	$1.68243	$1.88139	$2.36363
Nov 2021	$0.81218	$1.20019	$1.68243	$2.01237	$2.49461
Dec 2021	$0.82555	$1.20019	$1.68243	$2.02574	$2.50798

Table 34: PG&E Monthly CARE (GL-1) Gas Rate ($/therm)

Month	CARE Discount		Total CARE Charge	
	Baseline	Excess	Baseline	Excess
Jan 2022	($0.41947)	($0.51139)	$1.67790	$2.04554
Feb 2022	($0.41362)	($0.50553)	$1.65449	$2.02214
Mar 2022	($0.39034)	($0.48226)	$1.56138	$1.92902
Apr 2021	($0.28372)	($0.38006)	$1.13490	$1.52022
May 2021	($0.28124)	($0.37757)	$1.12497	$1.51030
June 2021	($0.28297)	($0.37942)	$1.13190	$1.51769
July 2021	($0.27764)	($0.37408)	$1.11054	$1.49634
Aug 2021	($0.28452)	($0.38097)	$1.13808	$1.52387
Sept 2021	($0.32818)	($0.42462)	$1.31270	$1.69850
Oct 2021	($0.37566)	($0.47211)	$1.50263	$1.88842
Nov 2021	($0.40185)	($0.49830)	$1.60742	$1.99321
Dec 2021	($0.40453)	($0.50098)	$1.61811	$2.00390

Pacific Gas and Electric Company®
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Revised Cal. P.U.C. Sheet No. 35436-G
Cancelling Revised Cal. P.U.C. Sheet No. 34288-G

GAS SCHEDULE G-1
RESIDENTIAL SERVICE

Sheet 2

BASELINE QUANTITIES:

The delivered quantities of gas shown below are billed at the rates for baseline use.

BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)

Baseline Territories ***	Summer (April-October) Effective Apr. 1, 2020		Winter Off-Peak (Nov,Feb,Mar) Effective Nov. 1, 2019		Winter On-Peak (Dec, Jan) Effective Dec. 1, 2019		(T) | (T)
P	0.39	(R)	1.88	(R)	2.16	(I)	
Q	0.59	(R)	1.55	(R)	2.16	(I)	
R	0.36	(R)	1.28	(R)	1.97	(I)	
S	0.39	(R)	1.38	(R)	2.06	(I)	
T	0.59	(R)	1.38	(R)	1.81	(I)	
V	0.62	(R)	1.51	(R)	1.84	(I)	
W	0.39	(R)	1.18	(R)	1.84	(I)	
X	0.49	(R)	1.55	(R)	2.16	(I)	
Y	0.69	(R)	2.15	(R)	2.65	(I)	

SEASONAL CHANGES:

The summer season is April-October, the winter off-peak season is November, February and March, and the winter on-peak season is December and January. Baseline quantities for bills that include the April 1, November 1 and December 1 seasonal changeover dates will be calculated by multiplying the applicable daily baseline quantity for each season by the number of days in each season for the billing period.

GAS SCHEDULE GL-1 Sheet 2
RESIDENTIAL CARE PROGRAM SERVICE

BASELINE QUANTITIES: The delivered quantities of gas shown below are billed at the rates for baseline use.

BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)

Baseline Territories **	Summer (April-October) Effective Apr. 1, 2020		Winter Off-Peak (Nov,Feb,Mar) Effective Nov. 1, 2019		Winter On-Peak (Dec, Jan) Effective Dec. 1, 2019		(T) | (T)
P	0.39	(R)	1.88	(R)	2.16	(I)	
Q	0.59	(R)	1.55	(R)	2.16	(I)	
R	0.36	(R)	1.28	(R)	1.97	(I)	
S	0.39	(R)	1.38	(R)	2.06	(I)	
T	0.59	(R)	1.38	(R)	1.81	(I)	
V	0.62	(R)	1.51	(R)	1.84	(I)	
W	0.39	(R)	1.18	(R)	1.84	(I)	
X	0.49	(R)	1.55	(R)	2.16	(I)	
Y	0.69	(R)	2.15	(R)	2.65	(I)	

SEASONAL CHANGES: The summer season is April-October, the winter off-peak season is November, February and March, and the winter on-peak season is December and January. Baseline quantities for bills that include the April 1, November 1 and December 1 seasonal changeover dates will be calculated by multiplying the applicable daily baseline quantity for each season by the number of days in each season for the billing period.

Pacific Gas and Electric Company
San Francisco, California
U 39

Revised Cal. P.U.C. Sheet No. 52702-E
Cancelling Revised Cal. P.U.C. Sheet No. 52397-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 RATES

Total Energy Rates ($ per kWh)	PEAK		OFF-PEAK	
Summer				
Total Usage	$0.48814	(I)	$0.42470	(I)
Baseline Credit (Applied to Baseline Usage Only)	($0.09018)	(R)	($0.09018)	(R)
Winter				
Total Usage	$0.39106	(I)	$0.37373	(I)
Baseline Credit (Applied to Baseline Usage Only)	($0.09018)	(R)	($0.09018)	(R)
Delivery Minimum Bill Amount ($ per meter per day)	$0.34810	(I)		
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	($39.30)	(R)		

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

(Continued)

Advice 6509-E-A
Decision

Issued by
Robert S. Kenney
Vice President, Regulatory Affairs

Submitted February 25, 2022
Effective March 1, 2022
Resolution

Pacific Gas and Electric Company
U 39 San Francisco, California

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Cancelling Revised Cal. P.U.C. Sheet No. 43414-E

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

SPECIAL CONDITIONS:

1. BASELINE (TIER 1) QUANTITIES: The following quantities of electricity are to be used to define usage eligible for the baseline credit (also see Rule 19 for additional allowances for medical needs):

BASELINE QUANTITIES (kWh PER DAY)

	Code B - Basic Quantities		Code H - All-Electric Quantities	
	Summer	Winter	Summer	Winter
Baseline Territory*	Tier I	Tier I	Tier I	Tier I
P	14.2	12.0	16.0	27.4
Q	10.3	12.0	8.9	27.4
R	18.6	11.3	20.9	28.1
S	15.8	11.1	18.7	24.9
T	6.8	8.2	7.5	13.6
V	7.5	8.8	10.9	16.9
W	20.2	10.7	23.6	20.0
X	10.3	10.5	8.9	15.4
Y	11.0	12.1	12.6	25.3
Z	6.2	8.1	7.0	16.5

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

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 5759-E Issued by Submitted February 14, 2020
Decision D.19-07-004 **Robert S. Kenney** Effective March 1, 2020
Vice President, Regulatory Affairs Resolution

Pacific Gas and Electric Company
U 39 San Francisco, California

Revised Cal. P.U.C. Sheet No. 52659-E
Cancelling Revised Cal. P.U.C. Sheet No. 52371-E

ELECTRIC SCHEDULE E-1 Sheet 1
RESIDENTIAL SERVICES

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; to single-phase and polyphase service in common areas in a multifamily complex (see Special Condition 8); and to all single-phase and polyphase farm service on the premises operated by the person whose residence is supplied through the same meter.

The provisions of Schedule S—Standby Service Special Conditions 1 through 6 shall also apply to customers whose premises are regularly supplied in part (but not in whole) by electric energy from a nonutility source of supply. These customers will pay monthly reservation charges as specified under Section 1 of Schedule S, in addition to all applicable Schedule E-1 charges. See Special Conditions 11 and 12 of this rate schedule for exemptions to standby charges.

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

RATES: Total bundled service charges are calculated using the total rates below. Customers on this schedule are subject to the delivery minimum bill amount shown below applied to the delivery portion of the bill (i.e. to all rate components other than the generation rate). In addition, total bundled charges will include applicable generation charges per kWh for all kWh usage.

Customers receiving a medical baseline allowance shall pay for all usage based on the rates shown below, and shall not pay the Wildfire Fund Charge. Customers receiving a medical baseline allowance shall also receive a 50 percent discount on the delivery minimum bill amount 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 RATES

Total Energy Rates ($ per kWh)	
Baseline Usage	$0.31465 (I)
101% - 400% of Baseline	$0.39454 (I)
High Usage Over 400% of Baseline	$0.49318 (I)
Delivery Minimum Bill Amount ($ per meter per day)	$0.34810 (I)
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	($39.30) (R)

(Continued)

Advice 6509-E-A Issued by **Robert S. Kenney** Vice President, Regulatory Affairs Submitted February 25, 2022
Decision Effective March 1, 2022
Resolution

Pacific Gas and Electric Company
U 39 San Francisco, California

Revised Cal. P.U.C. Sheet No. 53424-E
Cancelling Revised 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 **Robert S. Kenney** 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. Table 35 describes the baseline territories that were assumed for each climate zone.

Table 35: SCE Baseline Territory by Climate Zone

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

Summer Daily Allocations (June through September)

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

Winter Daily Allocations (October through May)

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

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

Sheet 12 (T)

SPECIAL CONDITIONS

1. Applicable rate time periods are defined as follows:

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

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

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

Revised Cal. PUC Sheet No. 73153-E
Cancelling Revised Cal. PUC Sheet No. 72676-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 weekdays, 4:00 p.m. to 9:00 p.m., as described in Special Conditions 1 and 3, below:

	Delivery Service Total[1]	Generation[2] UG***	Generation[2] DWREC[3]
Option 4-9 PM / Option 4-9 PM-CPP			
Energy Charge - $/kWh			
Summer Season - On-Peak	0.31186 (I)	0.21245 (I)	0.00000
Mid-Peak	0.31186 (I)	0.11358 (I)	0.00000
Off-Peak	0.24154 (I)	0.08653 (I)	0.00000
Winter Season - Mid-Peak	0.31186 (I)	0.14750 (I)	0.00000
Off-Peak	0.24154 (I)	0.10679 (I)	0.00000
Super-Off-Peak	0.23317 (I)	0.08321 (I)	0.00000
Baseline Credit**** - $/kWh	(0.08844) (I)	0.00000	
Basic Charge - $/day			
Single-Family Residence	0.031		
Multi-Family Residence	0.024		
Minimum Charge** - $/day			
Single Family Residence	0.346		
Multi-Family Residence	0.346		
Minimum Charge (Medical Baseline)** - $/day			
Single Family Residence	0.173		
Multi-Family Residence	0.173		
California Climate Credit[10]	(59.00) (I)		
California Alternate Rates for Energy Discount - %[4]	100.00*		
Family Electric Rate Assistance Discount - [4]	100.00		
Option 4-9 PM-CPP			
CPP Event Energy Charge - $/kWh		0.80000	
Summer CPP Non-Event Credit			
On-Peak Energy Credit - $/kWh		(0.15170)	
Maximum Available Credit - $/kWh*****			
Summer Season		(0.68554) (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 ($0.00020) per kWh is recovered in the UG component of Generation. (R)
**** The Baseline Credit applies up to 100% of the Baseline Allocation, regardless of Time of Use. The Baseline Allocation is 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 4719-E
Decision
2C8

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Vice President

(To be inserted by Cal. PUC)
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Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 73148-E
Cancelling Revised Cal. PUC Sheet No. 72670-E

Schedule D
DOMESTIC SERVICE

Sheet 2

(Continued)

RATES

	Delivery Service Total[1]	Generation[2] UG***	Generation[2] DWREC[3]
Energy Charge- $/kWh/Meter/Day			
Baseline Service			
Summer	0.17154 (I)	0.11259 (I)	0.00000
Winter	0.17154 (I)	0.11259 (I)	0.00000
Nonbaseline Service*			
101% - 400% of Baseline - Summer	0.25252 (I)	0.11259 (I)	0.00000
Winter	0.25252 (I)	0.11259 (I)	0.00000
High Usage Charge			
(Over 400% of Baseline) - Summer	0.34380 (I)	0.11259 (I)	0.00000
- Winter	0.34380 (I)	0.11259 (I)	0.00000
Basic Charge - $/Meter/Day			
Single-Family Accommodation	0.031		
Multi-Family Accommodation	0.024		
Minimum Charge** - $/Meter/Day			
Single-Family Accommodation	0.346		
Multi-Family Accommodation	0.346		
Minimum Charge (Medical Baseline)** - $/Meter/Day			
Single-Family Accommodation	0.173		
Multi-Family Accommodation	0.173		
California Climate Credit[10]	(59.00) (I)		

* Nonbaseline Service includes all kWh in excess of applicable Baseline allocations as described in Preliminary Statement, Part H, Baseline Service.
** The Minimum Charge is applicable when the Delivery Service Energy Charge, minus the DWRBC, plus the applicable Basic Charge is less than the Minimum Charge. The difference between these two amounts is the Balance of Minimum Charge and is included on a Customer's bill.
*** The ongoing Competition Transition Charge (CTC) of ($0.00020) per kWh is recovered in the UG component of Generation. (R)
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 Generation rates are applicable only to Bundled Service Customers. See Special Condition below for PCIA recovery.
3 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

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2C8

Southern California Edison Revised Cal. PUC Sheet No. 73151-E
Rosemead, California (U 338-E) Cancelling Revised Cal. PUC Sheet No. 72673-E

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

APPLICABILITY

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

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

TERRITORY

Within the entire territory served.

RATES

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

CARE Discount:

A 28.5 percent discount is applied to a CARE Customer's bill prior to the application of the Public Utilities Commission Reimbursement Fee (PUCRF) and any applicable user fees, taxes, and late payment charges. CARE Customers are required to pay the PUCRF and any applicable user fees, taxes, and late payment charges in full. In addition, CARE Customers are exempt from paying the CARE Surcharge of $0.01070 per kWh and the Department of Water Resources Bond Charge of $0.00652 per kWh. The 28.5 percent discount (which includes the exemption of the Fixed Recovery Charge of $0.00016 per kWh) in addition to these exemptions result in an average effective CARE Discount of 32.5 percent. (I) (I) (I)

(Continued)

(To be inserted by utility) Issued by (To be inserted by Cal. PUC)
Advice 4719-E Michael Backstrom Date Submitted Feb 15, 2022
Decision Vice President Effective Mar 1, 2022

7.2.3 Southern California Gas

Following are the SoCalGas natural gas tariffs applied in this study. Table 36 describes the baseline territories that were assumed for each climate zone.

Table 36: SoCalGas Baseline Territory by 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 for the 12-month period ending August 2021 according to the rates shown in Table 37. Historical natural gas rate data was only available for SoCalGas' procurement charges.[13] To estimate total costs by month, the baseline and excess transmission charges were assumed to be relatively consistence and applied for the entire year based on January 2021 and April 2021 costs. CARE rates reflect the 20 percent discount per the GR tariff.

Table 37: SoCalGas Monthly Gas Rate ($/therm)

Month	Procurement Charge	Transportation Charge		Total Charge	
		Baseline	Excess	Baseline	Excess
Jan 2022	$0.83569	$0.82487	$1.23877	$1.66056	$2.07446
Feb 2022	$0.60655	$0.82487	$1.23877	$1.43142	$1.84532
Mar 2022	$0.55921	$0.82487	$1.23877	$1.38408	$1.79798
Apr 2021	$0.31373	$0.80599	$1.20562	$1.11972	$1.51935
May 2021	$0.35684	$0.80599	$1.20562	$1.16283	$1.56246
June 2021	$0.39460	$0.80599	$1.20562	$1.20059	$1.60022
July 2021	$0.42622	$0.80599	$1.20562	$1.23221	$1.63184
Aug 2021	$0.44599	$0.80599	$1.20562	$1.25198	$1.65161
Sept 2021	$0.44425	$0.82487	$1.23877	$1.26912	$1.68302
Oct 2021	$0.57580	$0.82487	$1.23877	$1.40067	$1.81457
Nov 2021	$0.63799	$0.82487	$1.23877	$1.46286	$1.87676
Dec 2021	$0.65129	$0.82487	$1.23877	$1.47616	$1.89006

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

SOUTHERN CALIFORNIA GAS COMPANY Revised CAL. P.U.C. SHEET NO. 59651-G
LOS ANGELES, CALIFORNIA CANCELING Revised CAL. P.U.C. SHEET NO. 59610-G

Schedule No. GR Sheet 1
RESIDENTIAL SERVICE
(Includes GR, GR-C and GT-R Rates)

APPLICABILITY

The GR rate is applicable to natural gas procurement service to individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GT-R rate is applicable to Core Aggregation Transportation (CAT) service to individually metered residential customers, as set forth in Special Condition 11.

The California Alternate Rates for Energy (CARE) discount of 20%, reflected as a separate line item on the bill, is applicable to income-qualified households that meet the requirements for the CARE program as set forth in Schedule No. G-CARE.

TERRITORY

Applicable throughout the service territory.

RATES	GR	GR-C	GT-R
Customer Charge, per meter per day:	16.438¢	16.438¢	16.438¢
For "Space Heating Only" customers, a daily Customer Charge applies during the winter period from November 1 through April 30[1/]:	33.149¢	33.149¢	33.149¢

7.2.4 San Diego Gas & Electric

Following are the SDG&E electricity and natural gas tariffs applied in this study. Table 38 describes the baseline territories that were assumed for each climate zone.

Table 38: SDG&E Baseline Territory by Climate Zone

	Baseline Territory
CZ07	Coastal
CZ10	Inland
CZ14	Mountain

The SDG&E monthly gas rate in $/therm was applied on a monthly basis for the 12-month period ending August 2021 according to the rates shown in Table 39. CARE rates reflect the 20 percent discount per the G-CARE tariff.

Table 39: SDG&E Monthly Gas Rate ($/therm)

Month	Procurement Charge	Transportation Charge		Total Charge	
		Baseline	Excess	Baseline	Excess
Jan 2022	$0.83668	$1.43201	$1.70577	$2.26869	$2.54245
Feb 2022	$0.60727	$1.43201	$1.70577	$2.03928	$2.31304
Mar 2022	$0.55988	$1.43201	$1.70577	$1.99189	$2.26565
Apr 2021	$0.31401	$1.44464	$1.70732	$1.75865	$2.02133
May 2021	$0.35719	$1.44464	$1.70732	$1.80183	$2.06451
June 2021	$0.39498	$1.44464	$1.70732	$1.83962	$2.10230
July 2021	$0.42663	$1.44464	$1.70732	$1.87127	$2.13395
Aug 2021	$0.44642	$1.44464	$1.70732	$1.89106	$2.15374
Sept 2021	$0.44468	$1.44464	$1.70732	$1.88932	$2.15200
Oct 2021	$0.57637	$1.38238	$1.63573	$1.95875	$2.21210
Nov 2021	$0.63862	$1.38238	$1.63573	$2.02100	$2.27435
Dec 2021	$0.65194	$1.38238	$1.63573	$2.03432	$2.28767

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

All Customers:	Daily Therm Allowance
Summer (May 1 to October 31, inclusive)	0.493
Winter (November 1 to April 30, inclusive)	1.546

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 24598-G
Canceling Revised Cal. P.U.C. Sheet No. 17396-G

Sheet 1

SCHEDULE G-CARE

CALIFORNIA ALTERNATE RATES FOR ENERGY (CARE) PROGRAM

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 natural gas by the Utility.

DISCOUNT

The qualified customer will receive a 20% CARE discount on all customer, commodity, and transportation charges on their otherwise applicable service schedule. In addition, the customer will not pay the CARE portion of the Public Purpose Programs Surcharge as specified in Schedule G-PPPS.

SPECIAL CONDITIONS

ALL CUSTOMERS

1. Applicable Conditions. All special conditions contained in the customer's otherwise applicable schedule are applicable to service under this schedule.

2. Application and Eligibility Declaration.* An application and eligibility declaration, on a form authorized by the Commission, is required for service under the CARE program unless otherwise authorized by the Commission. Renewal of a customer's eligibility declaration, also referred to as recertification, will be required at the request of the Utility. N

3. Commencement of CARE Discount. Eligible customers shall begin receiving the CARE discount no later than one billing period after receipt of a completed and approved application by the Utility or as may otherwise be authorized by the Commission.

*Per SDG&E Advice Letter 3516-E-C/2854-G-C, submitted pursuant to Resolution M-4842, certain customer protections will be offered to eligible customers effective March 4, 2020 through April 16, 2021, or as otherwise extended. N N N

(Continued)

1C22
Advice Ltr. No. 2854-G-C
Decision No. M-4842

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Submitted Jun 3, 2020
Effective Mar 4, 2020
Resolution No.

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 35747-E
Canceling Revised Cal. P.U.C. Sheet No. 35358-E

Sheet 2

SCHEDULE TOU-DR1
RESIDENTIAL TIME-OF-USE

RATES

Total Rates:

Description – TOU DR1	UDC Total Rate		DWR BC + WF-NBC		EECC Rate + DWR Credit		Total Rate	
Summer:								
On-Peak	0.25074	I	0.00652	I	0.43976	I	0.69702	I
Off-Peak	0.25074	I	0.00652	I	0.19788	I	0.45514	I
Super Off-Peak	0.25074	I	0.00652	I	0.07083	I	0.32809	I
Winter:								
On-Peak	0.39008	I	0.00652	I	0.14857	I	0.54517	I
Off-Peak	0.39008	I	0.00652	I	0.08335	I	0.47995	I
Super Off-Peak	0.39008	I	0.00652	I	0.06442	I	0.46102	I
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.10159)	R					(0.10159)	R
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.10159)	R					(0.10159)	R
Minimum Bill ($/day)	0.350						0.350	

T

Note:
(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.
(2) Total Rates presented are for customers that receive commodity supply and delivery service from Utility.
(3) DWR-BC 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.

(Continued)

2C8 Issued by Submitted Mar 26, 2020
Advice Ltr. No. 3514-E **Dan Skopec** Effective Apr 1, 2020
Vice President
Decision No. D.20-01-021 Regulatory Affairs 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.; 9:00 p.m. - midnight	6:00 a.m. – 4:00 p.m. Excluding 10:00 a.m. – 2:00 p.m. in March and April; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m. 10:00 a.m. – 2:00 p.m. in March and April
TOU Period – Weekends and Holidays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

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

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

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

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

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 35702-E
Canceling Revised Cal. P.U.C. Sheet No. 35307-E

SCHEDULE DR

Sheet 1

RESIDENTIAL SERVICE
(Includes Rates for DR-LI)

APPLICABILITY

This Schedule is optionally available to domestic service for lighting, heating, cooking, water heating, and power, or combination thereof, in single family dwellings, flats, and apartments, separately metered by the utility; to service used in common for residential purposes by tenants in multi-family dwellings under Special Condition 8; to any approved combination of residential and nonresidential service on the same meter; and to incidental farm service under Special Condition 7.

This schedule is also applicable to customers qualifying for the California Alternate Rates for Energy (CARE) Program and/or Medical Baseline, residing in single-family accommodations, separately metered by the Utility, and may include Non-profit Group Living Facilities and Qualified Agricultural Employee Housing Facilities, if such facilities qualify to receive service under the terms and conditions of Schedule E-CARE. The rates for CARE and Medical Baseline customers are identified in the rates tables below as DR-LI and DR-MB rates, respectively.

Customers on this schedule may also qualify for a semi-annual California Climate Credit $(64.17) per Schedule GHG-ARR. R

TERRITORY

Within the entire territory served by the Utility.

RATES

Total Rates: T

Description - DR Rates	UDC Total Rate		DWR BC + WF-NBC		EECC Rate + DWR Credit		Total Rate	
Summer:								
Up to 130% of Baseline Energy ($/kWh)	0.14915	R	0.00652	I	0.23639	I	0.39206	I
131% - 400% of Baseline ($/kWh)	0.25074	I	0.00652	I	0.23639	I	0.49365	I
Above 400% of Baseline ($/kWh)	0.25074	I	0.00652	I	0.23639	I	0.49365	I
Winter:								
Up to 130% of Baseline Energy ($/kWh)	0.28849	I	0.00652	I	0.09705	I	0.39206	I
131% - 400% of Baseline ($/kWh)	0.39008	I	0.00652	I	0.09705	I	0.49365	I
Above 400% of Baseline ($/kWh)	0.39008	I	0.00652	I	0.09705	I	0.49365	I
Minimum Bill ($/day)	0.350	I					0.350	I

(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
Effective Discount	**40%**	**39%**	**38%**	**38%**	**36% R**	**35%**

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

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

(Continued)

1C5 Issued by Submitted Dec 30, 2021
Advice Ltr. No. 3928-E **Dan Skopec** Effective Jan 1, 2022
Vice President

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 for the 12-month period ending August 2021 according to the rates shown

in Table 40. The distribution charge was $0.4835/therm for Tier 1 and $1.0426/therm for Tier 2. The monthly service charge applied was $10.94 per month per the G-1 tariff in effect at the time of the analysis.

Table 40: CPAU Monthly Gas Rate ($/therm)

Effective Date	Commodity Rate	Cap and Trade Compliance Charge	Transportation Charge	Carbon Offset Charge	G1 Tier 1 Volumetric Totals	G1 Tier 2 Volumetric Totals
Jan 2022	$0.77140	$0.04860	$0.15000	$0.04000	$1.53900	$1.83144
Feb 2022	$0.53600	$0.04860	$0.15000	$0.04000	$1.30360	$1.81874
Mar 2022	$0.53700	$0.04860	$0.15000	$0.04000	$1.30460	$1.8565
Apr 2022	$0.59750	$0.07680	$0.14404	$0.04000	$1.38734	$1.8363
May 2021	$0.39010	$0.04860	$0.12200	$0.04000	$1.10450	$1.8889
June 2021	$0.39820	$0.04860	$0.12214	$0.04000	$1.11274	$1.89714
July 2021	$0.48000	$0.04860	$0.12274	$0.04000	$1.22034	$2.04394
Aug 2021	$0.54920	$0.04860	$0.12274	$0.04000	$1.28954	$2.11314
Sept 2021	$0.52170	$0.04860	$0.12274	$0.04000	$1.26204	$1.78012
Oct 2021	$0.71750	$0.04860	$0.12274	$0.04000	$1.45784	$1.83222
Nov 2021	$0.75050	$0.04860	$0.12274	$0.04000	$1.49084	$1.83472
Dec 2021	$0.63210	$0.04860	$0.12274	$0.04000	$1.37244	$1.80442

RESIDENTIAL ELECTRIC SERVICE

UTILITY RATE SCHEDULE E-1

A. APPLICABILITY:

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

B. TERRITORY:

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

C. UNBUNDLED RATES:

Per kilowatt-hour (kWh)	Commodity	Distribution	Public Benefits	Total
Tier 1 usage	$0.08339	$0.04971	$0.00447	$0.13757
Tier 2 usage Any usage over Tier 1	0.11569	0.07351	0.00447	0.19367
Minimum Bill ($/day)				0.3283

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:
This Rate Schedule applies anywhere the City of Palo Alto provides Electric Service.

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

	Per kWh
Export electricity compensation rate	$0.1078

7.2.6 Sacramento Municipal Utilities District (Electric Only)

Following are the SMUD electricity tariffs applied in this study.

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

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

7.2.7 Fuel Escalation Assumptions

The average annual escalation rates in Table 41 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 41: 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 Summary of Measures by Package

Table 42Table provides the details of the measures in each of the efficiency package by climate zone and case. Table 42 presents the measures for all the single family efficiency packages and . **Error! Reference source not found.** Table 43 presents the measures for all the ADU efficiency packages.

Table 42: Single Family Efficiency Package Measures

Climate Zone	3 ACH50	R-10 Slab	Attic	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 vs R-38				X	
2		X	R-60 vs R-38			X	X	X
3			R-60 vs R-30			X	X	X
4		X	R-60 vs R-38			X	X	X
5			R-49 vs R-30			X	X	X
6			R-60 vs R-30			X	X	X
7			R-49 vs R-30				X	X
8			R-60 vs R-38			X	X	X
9			R-60 vs R-38			X	X	X
10			R-60 vs R-38	X		X	X	X
11		X	R-60 vs R-38	X		X	X	X
12		X	R-60 vs R-38	X		X	X	X
13		X	R-60 vs R-38	X		X	X	X
14	X	X	R-60 vs R-38	X		X	X	X
15		X	R-60 vs R-38	X		X	X	X
16			R-60 vs R-38		X	X	X	

Table : Single Family Mixed Fuel Efficiency + PV + Battery Package Measures

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 vs R-38				X	X	X
3			R-38 vs R-30			X		X	X
4		X	R-49 vs R-38				X	X	X
5			R-49 vs R-30			X		X	X
6			R- 49 vs R-30				X	X	X
7			R-49 vs R-30					X	X
8			R- 49 vs R-38				X	X	X
9			R- 49 vs R-38				X	X	X
10				X			X	X	X
11		X	R-49 vs R-38	X			X	X	X
12		X	R- 49 vs R-38	X			X	X	X
13		X	R- 49 vs R-38	X			X	X	X
14	X	X	R- 49 vs R-38	X			X	X	X
15		X	R- 49 vs R-38	X			X	X	X
16			R- 49 vs R-38		X		X	X	

Table 43: ADU Efficiency Package Measures

Climate Zone	3 ACH50	R-10 Slab	0.25 Roof Solar Reflectance	0.24 U-Factor / 0.50 SHGC Windows	Ductless VCHP	Ductless	Basic Compact Hot Water Credit
1		X			X	X	
2		X			X	X	X
3					X	X	X
4		X			X	X	X
5					X	X	X
6					X	X	X
7					X	X	X
8					X	X	X
9					X	X	X
10			X		X	X	X

11		X	X		X	X	X
12		X	X		X	X	X
13		X	X		X	X	X
14	X	X	X		X	X	X
15		X	X		X	X	X
16				X	X	X	

The efficiency measures added to the All-Electric prescriptive package in Climate Zones that were not compliant are shown in Table 44 and Table 45.

Table 44: Single Family All-Electric Code Compliant Efficiency Measures

Climate Zone	0.24 U-Factor / 0.50 SHGC Windows
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	X

Table 45: ADU All-Electric Code Compliant Efficiency Measures

Climate Zone	3 ACH50	R-49 vs R-38 Attic Insulation	0.30 U-Factor / 0.50 SHGC Windows	0.24 U-Factor / 0.50 SHGC Windows	Improved HVAC Fan Efficiency: 0.35 W/cfm	Basic Compact Hot Water Credit
1						
2						
3						
4						X
5			X			X
6						X
7						X
8					X	X
9					X	X
10					X	X
11						
12						
13						X
14					X	X
15					X	X
16	X	X		X	X	

Get In Touch

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

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

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

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

Visit LocalEnergyCodes.com to access our resources and sign up for newsletters	Contact info@localenergycodes.com for no-charge assistance from expert Reach Code advisors	Follow us on Twitter

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Last modified: 2022/08/08
Revision: 1.0

2022 Codes

Nonresidential New Construction Reach Code Cost Effectiveness Study

Prepared by:
Avani Goyal, TRC Companies Inc.

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

Legal Notice

Acronym List

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)**
8/9/2022	Original Release	-

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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 and the attached workbook present 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 in 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.

Results across all prototypes indicate that efficiency measures included in the analysis are cost-effective, both On-Bill and TDV, across all climate zones when added to the mixed-fuel baseline prototype. Code compliance is evaluated using the current CBECC v1.0 software version released in June 2022 and may change as future iterations changes their standard design assumptions. All-electric results by prototype are summarized below:

- **Medium Office:** Due solely to energy modeling limitations, all-electric space heating is predominantly achieved through electric resistance which limits operational benefits and thus cost-effectiveness. All-electric code minimum with energy efficiency and load flexibility measures is cost effective in some mild climate zones but achieves compliance on two of the three metrics, with efficiency TDV margin being the most challenging.
- **Medium Retail:** All-electric code minimum packages are cost effective in most climate zones. Additional energy efficiency measures enhance the cost effectiveness and achieve compliance in climate zones 2 to 15. These results are primarily driven by cost-equivalency in the all-electric package compared to a mixed-fuel package, and the majority of the space heating is achieved using heat pumps.
- **Quick Service Restaurant:** Electrifying only the HVAC and service water heating (no cooking equipment) combined with efficiency and solar PV measures achieves compliance and is cost effective in many climate zones. Electrification with cooking equipment could be On-bill cost effective in CPAU and SMUD territories only with energy efficiency and load flexibility measures and achieves compliance.
- **Small Hotel:** 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. Energy efficiency measures and load flexibility or solar PV achieve compliance and are TDV cost effective across many climate zones. On-Bill cost-effectiveness is limited to CPAU and SMUD territories, which may be affected by higher peak loads and overnight occupancy, despite most of the heating being provided with heat pumps. Solar PV improves On-bill cost effectiveness but not enough to make it positive and does not achieve compliance across all metrics. The team evaluated an additional scenario with Packaged Terminal Heat Pump (PTHP) that improved all-electric code minimum cost effectiveness considerably due to high first cost savings but does not achieve compliance.

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. Although a cost-effectiveness study is only required to amend Part 6 of the California building code, it is important to understand the economic impacts of any 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 LocalEnergyCodes.com. Local jurisdictions that are considering adopting an ordinance are encouraged to contact the program for further technical support at info@localenergycodes.com .

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. 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.

TRC performed cost-effectiveness analysis for the following scenarios above prescriptive 2022 Title 24 code requirements in all 16 California climate zones (CZs):

- Code-minimum all-electric new construction, compared to a prescriptive mixed-fuel (i.e., gas and/or electric fueled appliances) compliance pathways where applicable.
- Energy efficiency measures, mixed-fuel packages, and all-electric packages
- Load flexibility measures
- Solar PV and Battery

TRC 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 few gaps in functionalities and standard design assumptions in this software version, the Reach Code team has been actively coordinating with software team to inform future software updates.

Title 24 is maintained and updated every three years by two state agencies: the California Energy Commission (the Energy Commission) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local energy efficiency ordinances—or reach codes—that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). 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 may 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 new construction nonresidential buildings as a starting point for additional measure definitions. Importantly, the current 2022 reach code report introduced a new restaurant building type and updated the modeling and cost assumptions.

2 Methodology and Assumptions

The Reach Codes 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. Using this relationship, the Reach Code Team calculated the cost for each building in each climate zone. In most cases, the Reach Code Team took the average of the costs provided by the contractor and the costs provided by the designer to use in the cost-effectiveness analysis. In some limited cases where costs provided by one source were unlikely to be representative of the measure, the Reach Code Team used the costs from only the other source. 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. 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

CZs	Electric / Gas Utility	Electricity	Natural Gas
Investor-Owned Utilities			
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 / -2 / -3	G-10 (GN-10)
7, 10, 14	San Diego Gas and Electric Company (SDG&E)	EECC-TOU-A-P / EECC	GN-3
Publicly Owned Utilities			
4	City of Palo Alto Utilities (CPAU)	E-2	G-2
12	Sacramento Municipal Utilities District (SMUD)	CI-TOD 1(CITS-0 / -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). This was 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.

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 that due to updates in functionalities and standard design assumptions.

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.

2.3 2022 T24 Compliance Metrics

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,

1. Efficiency TDV Compliance Margin
2. Total TDV Compliance Margin
3. Source Energy Margin

2022 Title24 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 water heating and covered process loads. Efficiency TDV accounts for all compliant end-uses but does not include the impacts of PV and battery storage. Total TDV metric includes compliant end-uses accounting for PV and battery

storage contributions. Source energy is evaluated based on fuel used for power generation, assuming utilities meet all 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 renewable portfolio standard projections. For the 2022 code cycle, the multipliers incorporate GHG from methane and refrigerant leakage, which are two significant sources of GHG emissions (NORESCO 2020). There are 32 strings of multipliers, with a different string for each California CZ and each fuel type (metric tons of CO_2 per kWh for electricity and metric tons of CO_2 per therm for natural gas).

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
- Stand-alone 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 and our best understanding of the Standard Design assumptions that would be included in 2022 Title 24 Alternative Calculation Method (ACM). The Reach Code Team reviewed the 2022 T24 ACM HVAC system map to ensure alignment, differences are discussed in subsequent sections. We 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 software as described in Section 2.2. Any misalignments have been reported back to the software team for future software iterations.

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 climate zones 2 to 15, the HVAC design includes three single zone heat pump (SZHP) units (VAV or constant volume, depending on capacity) based on prescriptive requirements and one mixed-fuel single zone air conditioner (SZAC) variable volume of cooling capacity between 35 and 45 tons for the core zone, along with a gas furnace.

    However, the 2022 Title24 ACM System Map update suggests a packaged single zone heat pump for the large core zone, in which case the baseline model would already be all-electric. The team chose to deviate from the system map and still assumed a mixed fuel system as described above for the large core zone to evaluate cost effectiveness of a scenario where buildings may choose the more popular mixed fuel packaged system for large capacity zones.
  - In CZs 1 and 16, the smaller capacity (<240 kBtuh) thermal zones may have dual fuel heat pumps or single zone packaged mixed fuel systems with furnace, depending upon capacity. The core zone with 35-to-45-ton cooling capacity is assumed to have packaged single zone VAV AC unit with gas furnace.

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.

Similar to CZs 2 to 15, the assumption deviates from 2022 Title24 ACM System Map that suggests a single zone dual fuel heat pump for the large core zone.

- 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 Mixed-fuel Prototype Characteristics

	Medium Office	Medium Retail	Quick Service Restaurant	Small Hotel
Conditioned floor area (ft²)	53,628	24,563	2,501	42,554 (77 guest rooms)
Number of stories	3	1	1	4
Window-to-Wall Area ratio	0.33	0.07	0.11	0.14
Window U-factor/SHGC	U-factor: CZ 1-8, 10, 16 – 0.36 CZ 9, 11-15 – 0.34 SHGC: CZ 1-8, 10, 16 – 0.25 CZ 9, 11-15 – 0.22	U-factor: CZ 1-8, 10, 16 – 0.36 CZ 9, 11-15 – 0.34 SHGC: CZ 1-8, 10, 16 – 0.25 CZ 9, 11-15 – 0.22	U-factor: CZ 1-8, 10, 16 – 0.36 CZ 9, 11-15 – 0.34 SHGC: CZ 1-8, 10, 16 – 0.25 CZ 9, 11-15 – 0.22	Nonresidential: U-factor: CZ 1-8,10,16 – 0.36 CZ 9, 11-15 –0.34 SHGC: CZ 1-8,10,16 – 0.25 CZ 9, 11-15 – 0.22 Guest Rooms: U-factor: 0.36 SHGC: 0.25
Solar PV size	123 kW – 204 kW Depending on CZ	64 kW – 87 kW Depending on CZ	None	17 kW – 25 kW Depending on CZ
Battery Storage	217 kWh – 360 kWh Depending on CZ	70 kWh – 94 kWh Depending on CZ	None	16 kWh – 24 kWh Depending on CZ
HVAC System	VAV reheat system with packaged rooftop units, gas boilers, VAV terminal units with hot water reheat	CZ 1 Heat recovery for Core Retail space only CZ 1, 16 < 65 kBtu/h: SZAC with gas furnace > 65 kBtu/h and < 240 kBtu/h: SZHP and gas	< 65 kBtu/h: SZAC + gas furnace > 65 kBtu/h: SZAC VAV	Nonresidential: VAV reheat system with packaged rooftop units, gas boilers, VAV terminal units with hot water reheat Guest Rooms: SZAC with gas furnaces

	Medium Office	Medium Retail	Quick Service Restaurant	Small Hotel
		furnace (i.e., dual fuel heat pump). VAV. > 240 kBtu/h: SZAC VAV with gas furnace CZ 2-15 < 65 kBtu/h: SZAC with gas furnace > 65 kBtu/h and < 240 kBtu/h: SZHP VAV > 240 kBtu/h: SZAC VAV with gas furnace		
SHW System	5-gallon electric resistance water heater	5-gallon electric resistance water heater	100-gallon gas water heater	Nonresidential: 30-gallon electric resistance water heater Guest rooms: 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:

All-electric

- Heat pump or electric space heating
- Heat pump or electric water heaters
- Electric cooking
- Electric clothes dryer
- Increased electrical panel capacity
- Eliminating natural gas connections

Energy Efficiency

- Envelope (high performance windows)
- 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 All-Electric

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. This includes 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.

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 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 system in mixed fuel baseline and all-electric scenario is 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

		 Medium Office	 Medium Retail	 Quick Service Restaurant	 Small Hotel
HVAC	Mixed-fuel Baseline	Packaged DX + VAV with hot water reheat. Central **gas** boilers.	Core zone (>30 ton): Packaged SZAC + **gas** furnace Other small zones: SZHP, or dual fuel heat pump for CZ 1 and 16	Packaged SZAC + **gas** furnace	Nonresidential: Packaged DX + VAV with hot water reheat. Central **gas** boilers. Guest Rooms: Packaged SZAC + **gas** furnaces
	All-Electric	Packaged DX + VAV with electric **resistance** reheat.	All zones and CZs: Single zone packaged **heat pumps**	Single zone packaged **heat pumps**	Nonresidential: Packaged DX + VAV with electric **resistance** reheat Guest Rooms: SZHPs
SHW	Mixed-fuel Baseline	Electric **resistance** with storage	Electric **resistance** with storage	**Gas** storage water heater	Nonresidential: Electric **resistance** storage Guest Rooms: Central **gas** storage with recirculation
	All-Electric			Unitary **heat pump** water heater	Nonresidential: Electric **resistance** storage Guest Rooms: Central **heat pump water heater** 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. 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.[1] 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
Description	Packaged units, boilers, hot water piping, VAV boxes, ductwork, grilles	Packaged units, electric resistance VAV boxes, electric circuitry, ductwork, grilles	VAV Boxes, electric infrastructure
Material	$491,630	$438,555	$(53,075)
Labor	$173,816	$102,120	$(71,696)
Electric Infrastructure	$0	$112,340	$112,340
Gas Infrastructure	$17,895	$0	$(17,895)
Overhead & CZ adjustment **	$266,761	$250,114	$(16,647)
TOTAL	**$950,102**	**$903,129**	**$(46,973)**

** 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 rooftop air conditioners (ACs) with gas furnaces. Based on fan control requirements in Section 140.4(m), units with cooling capacity ≥ 65,000 Btu/h have variable air volume fans, while smaller units have constant volume fans. For the Medium Retail all-electric HVAC design, the Reach Code Team assumed packaged heat pumps instead of the packaged ACs. 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.

[1] 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

Table 5. Medium Retail Average Mechanical System Costs

Components (HVAC Only)	Baseline – Mixed Fuel	Proposed – All-electric	Incremental Cost
Description	Single zone AC + furnace, SZHP, or dual fuel SZHP, depending upon capacity and CZ	SZHP	SZHP, Avoided gas infrastructure cost
HVAC – Material	$183,157	$189,160	$6,003
HVAC – Labor	$52,886	$54,785	$1,899
Electric Infrastructure	$0	$0	-
Gas Infrastructure	$17,895	$0	$(17,895)
Overhead & CZ adjustment **	$98,519	$94,600	$(3,919)
TOTAL	**$352,458**	**$338,546**	**$(13,912)**

** 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 ≥ 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 + SWH Material	$50,065	$52,785	$2,719
HVAC + SWH 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 thirteen VAV terminal boxes with hot water reheat coil. The SHW design includes a small electric water heater with storage tank. 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. For the guest room all-electric HVAC system, we assumed SZHPs and a central heat pump water heater serving all guest rooms and laundry. 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, including the lower cost of packaged terminal heat pumps serving the guest rooms compared to split DX/furnace systems with individual flues.

Table 7. Small Hotel HVAC and Water Heating System Costs

Components	 Baseline – Mixed Fuel	 Proposed – All-electric	Incremental Cost
Description	Non-residential spaces: Packaged units, boilers, hot water piping, VAV boxes, ductwork, grilles, gas water heater for laundry 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 Guest rooms: SZHP, central heat pump water heater	HVAC (NR and Guest Rooms) Electrification SHW (Laundry Room and Guest Rooms)
HVAC - Material	$802,004	$625,642	$(176,361)
HVAC - Labor	$366,733	$282,394	$(84,339)
SHW - Material	$55,829	$139,087	$83,258
SHW - Labor	$11,780	$15,080	$3,300
Electric Infrastructure	$-	$119,625	$119,625
Gas Infrastructure	$74,943	$-	$(74,943)
Overhead & CZ adjustment **	$518,741	$461,001	$(57,739)
TOTAL	**$1,830,029**	**$1,642,830**	**$(187,199)**

** 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 2022 nonresidential reach code analysis (Statewide IOU Team 2022). 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	Baseline – Mixed Fuel	Proposed – All-electric (non "HS" scenario)	Incremental Cost
Description	Gas based appliances	Electric cooking appliance	Cooking appliance electrification
Cooking equipment cost	$21,649	$43,534	$21,886
TOTAL	**$21,649**	**$43,534**	**$21,886**

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 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 means 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 measures. 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

	Baseline Equipment	Proposed Equipment	Electrical Infrastructure Impact	Incremental Cost
Medium Office	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
Medium Retail	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
Quick Service Restaurant	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
Small Hotel	Guest rooms HVAC: Single zone AC plus furnace Non-residential spaces HVAC: Hot water reheat system with gas boiler plant and VAV boxes with hot water reheat coils. Water heating: Gas water heating serving both laundry and guest rooms. Process: Gas dryers.	Guest rooms HVAC: SZHPs Non-residential spaces HVAC: VAV boxes with electric resistance reheat coils. Water heating: Heat pump water heating serving both laundry and guest rooms. Process: 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
Meter, including Pressure Regulator, and Earthquake Valve	Low load CZ (CZ 2-15)	$11,056
	High load CZ (CZ 1,16)	$15,756
Gas lateral	Cost per linear foot of 1" CSST	$40
Connection charges	Includes street cut and plan review	$1,015
Interior plumbing distribution	Cost per linear foot of 1" CSST	$40

Table 12. Total Gas Infrastructure Cost Estimates by Building Type

		Total gas infrastructure cost	
Building Prototype	**Interior plumbing distribution length (ft)**	**Low load CZ**	**High load CZ**
Medium Office	100	$17,307	$22,007
Medium Retail	100	$17,307	$22,007
Quick Service Restaurant	100	$2,017*	
Small Hotel	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)[2], 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. The subsections below describe the energy efficiency measures that the Team analyzed, including description, modeling approach, and specification.

3.2.2.1 Envelope

4. **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.

   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.

5. **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.

6. **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.

[2] https://title24stakeholders.com/

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)

7. **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. 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.

8. **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 for laundry systems. Refer to DEER Deemed measure SWAP005-01 for more information (California Public Utilites Commission 2022).

   Modeling: Reduced the total runtime of each cycle use 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).

9. **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 105-140ºF temperature range.

. The Team reduced the DHW energy consumption by 0.4 - 0.7% depending on CZ in a post-processing of the model.

10. **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.

11. **Guest Room Ventilation and Fan Power:** Uses the 2021 IECC fan power limitation requirements for ventilation fans under 1/12 horsepower, and it approximates the Small Hotel guestroom control requirements of ASHRAE 90.1, which requires shutting off ventilation within five minutes of all occupants leaving the room and changing the cooling setpoint to at least 80ºF and heating setpoint to at most 60ºF.

    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.

12. **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 zones the Medium Retail prototype and the Dining Zone in the QSR prototype.

3.2.2.3 Lighting

13. **Interior lighting reduced lighting power density:** Update lighting power densities (LPD, measured as Watts/ft^2) 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^2

Medium Retail

- Storage: 0.36 W/ft^2
- Retail sales: 0.86 W/ft^2
- Main entry lobby: 0.63 W/ft^2

QSR

- Dining: 0.41 W/ft^2
- Kitchen: 0.86 W/ft^2

Small Hotel

Stairs: 0.54 W/ft^2
Corridor: 0.36 W/ft^2
Lounge: 0.50 W/ft^2

The measures are summarized below by building type, including measure costs, in Table 13.

Table 13. Efficiency Measures Applicability, Costs, and Sources

Measure Applicability

- • Included in energy efficiency measures (mf, eff, ae eff)
- - 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
Envelope									
1. Cool Roof	For low slope roofs: ASR = 0.63 TE = 0.75	For low slope roofs: ASR = 0.7 TE = 0.85	•	–	–	–	–	$0.04/ft^2	Final Nonresidential High Performance Envelope Case Report (Statewide CASE Team 2020 B)
2. Efficient Vertical Fenestration	U-factor = 0.36 SHGC = 0.25	U-factor = 0.34 SHGC = 0.22	•	•	–	•	•	$1.75/ft^2	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.
HVAC and SHW									
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 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 Utilites Commission 2022)

Measure Applicability • Included in energy efficiency measures (mf, eff, ae eff) - 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 and annual $130.9 savings	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 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
Lighting									
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:

1. **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.

2. **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.

   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.

3. **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
1. Smart Thermostat	●	-	-	-	$0	Capability already required
2. Demand Control HPWH	-	-	●	-	$5,400	An additional 100-gallon tank, plumbing hardware, and related labor hours
3. Demand Response Lighting	●	-	-	-	$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 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 all-electric scenarios. For medium office and retail, the prescriptive PV sizes are large enough to fill available roof space, hence additional solar PV was not considered for the two prototypes. For Quick Service Restaurant and Small Hotel, no PV was required, or the required PV size was not large enough in the code compliant models respectively. For the Reach Code analysis, the Team evaluated additional solar PV for all-electric scenarios for the two building types. The additional PV size is calculated based on available roof space, assuming 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 15below.

Table 15. Additional Solar PV Measure Summary

Measure	Med Office	Med Retail	QSR	Small Hotel	Incremental Cost	Cost Source
1. Solar PV	-	-	●	●	First Cost: $3.20/W Inverter replacement cost at 10-yr: $0.15/W Annual Maintenance Cost: $0.02/W ITC Federal Incentive: 26%	National Renewable Energy Laboratory (NREL) Q1 2016 (National Renewable Energy Laboratory 2016) E3 Rooftop Solar PV System Report (Energy and Environmental Economics, Inc. 2017)

Upfront solar PV system costs are reduced by the federal income tax credit (ITC), approximately 26 percent due to a phased reduction in the credit through the year 2022. PV energy output is built into CBECC and is based on NREL's PVWatts calculator, which includes long term performance degradation estimates.

Battery 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 could not evaluate additional battery system measure since the compliance software does not apply the appropriate battery control "Time of Use" in standard design. This impacts the incremental energy cost or TDV benefits analysis.

3.3 Measure Packages

The Reach Code Team compared a baseline (mixed-fuel) Title 24 prescriptive package to a mixed-fuel efficiency package 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 + 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 (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.

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 cost-effective neither on On-Bill or (Total) TDV basis.

Results across all prototypes indicate that efficiency measures are cost-effective, both On-Bill and TDV, across all climate zones when added to the mixed-fuel baseline prototype. All-electric cost effectiveness results by prototype can be summarized as:

- **Medium Office** (Figure 1): Due to modeling limitations, all-electric space heating is predominantly achieved through electric resistance, which limits operational benefits and thus cost-effectiveness. 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 code minimum packages are cost effective in the majority of climate zones. This is primarily driven by cost-equivalency in the all-electric package compared to a mixed-fuel package, and that the majority of space heating is achieved using heat pumps. Energy efficiency measures extend cost effectiveness to most climates except 16.
- **Quick Service Restaurant** (Figure 3)**:** All-electric HVAC and SHW alone are only cost effective in CPAU and SMUD territories, On-Bill. Adding efficiency and load flexibility measures is cost-effective in On-Bill and TDV in CZs 1, 3, and 5 (PG&E territory).
- **Small Hotel** (Figure 4)**:** The all-electric hotel has tremendous cost savings compared to a mixed-fuel package, mostly due to the avoidance of gas infrastructure to each guest room. Efficiency and load flexibility measures are necessary to achieve TDV cost-effective packages and achieve cost-effectiveness in nearly all CZs except 1 and 16. On-Bill cost-effectiveness is limited to CPAU, SMUD, and SCE (CZ15 only) territories, which may be driven by higher peak loads and overnight occupancy, despite most of the heating being provided with heat pumps.

4.1 Medium Office

The first cost savings related to boiler and gas infrastructure supports cost effectiveness for all-electric medium office building.

- Adding energy efficiency measures over mixed fuel code minimum is on-bill cost effective in all climate zones.

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
	Utility	PG&E	PG&E	PG&E	PG&E / CPAU	PG&E / SCG	SCE	SDG&E	PG&E	SCE	SDG&E / SCE	PG&E	PG&E / SMUD	PG&E	SDG&E / SCE	SCE	PG&E
Prototype	Package																
Medium Office (MO)	Mixed Fuel + Energy Efficiency	Both	Both	Both	Both / Both	Both / Both	Both	Both	Both	Both	Both / Both	Both	Both / Both	Both	Both / Both	Both	Both
	All Electric Code Minimum Efficiency	Results for all-electric designs will be added in next version															
	All Electric + Energy Efficiency																
	All-Electric Energy Efficiency + Load Flexibility																

4.2 Medium Retail

2022 Title 24 prescriptively requires heat pump in most scenarios already. This report evaluates the exceptional scenarios such as CZ1 and 16 or large thermal zones where all-electric heat pump is not required prescriptively.

- Mixed fuel baseline with energy efficiency measures is cost effective across all climate zones.

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
	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				CPAU	SCG					SCE		SMUD		SCE		
Retail (RE)	Mixed Fuel + Efficiency Measures	Both	Both	Both	Both / Both	Both / Both	Both	Both	Both	Both	Both / Both	Both	Both / Both	Both	Both / Both	Both	Both
	All Electric Code Minimum Efficiency	Results for all-electric designs will be added in next version															
	All Electric Energy Efficiency																

For climate zones 2 to 15, positive energy cost savings and cost parity in single zone packaged system between mixed fuel system with furnace heating and efficient all-electric heat pump supports cost effectiveness. It is relatively challenging to achieve cost effectiveness in climate zones 1 and 16, since natural gas furnace or electric resistance are typically installed in colder climates. Some energy cost impacts are offset by higher incremental cost savings going from mixed fuel system (SZAC+furnace or dual fuel heat pump) to all-electric heat pump.

4.3 Quick Service Restaurant (QSR)

High incremental cost for HVAC and SHW electrification makes restaurant electrification challenging. The cooking electrification is very expensive and hence "HS" packages are evaluated that does not consider cooking equipment electrification. This affects the cost effectiveness since gas infrastructure cost savings cannot be utilized.

- Mixed fuel baseline with energy efficiency measures is cost effective and compliant across all climate zones.

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 / CPAU	PG&E / SCG	SCE	SDG&E	PG&E	SCE	SDG&E / SCE	PG&E	PG&E / SMUD	PG&E	SDG&E / SCE	SCE	PG&E
Prototype	Package																
Quick-Serve Restaurant (QSR)	Mixed Fuel + Efficiency Measures	Both	Both	Both	Both / Both	Both / Both	Both	Both	Both	Both	Both / Both	Both	Both / Both	Both	Both / Both	Both	Both
	All Electric HS Code Minimum Efficiency	Results for all-electric designs will be added in next version															
	All Electric HS Energy Efficiency																
	All-Electric HS Energy Efficiency + Load Flexibility																
	All Electric HS Energy Efficiency + PV																

4.4 Small Hotel

High incremental costs for HVAC, SHW and clothes dryer electrification negatively impacts the cost effectiveness of small hotel electrification. 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 high incremental cost savings as compared to a baseline of mixed fuel single zone packaged system and hence cost effective in many climate zones.

- Mixed fuel baseline with energy efficiency measures is cost effective across all climate zones.
-

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
	Utility	PG&E	PG&E	PG&E	PG&E / CPAU	PG&E / SCG	SCE	SDG&E	PG&E	SCE	SDG&E / SCE	PG&E	PG&E / SMUD	PG&E	SDG&E / SCE	SCE	PG&E
Prototype	Package																
Small Hotel (SH)	Mixed Fuel + Efficiency Measures	Both	Both	Both	Both / Both	Both / Both	Both	Both	Both	Both	Both / Both	Both	Both / Both	Both	Both / Both	Both	Both
	All Electric Code Minimum Efficiency	Results for all-electric designs will be added in next version															
	All Electric Energy Efficiency																
	All Electric Code Minimum Efficiency (PTHP)																
	All Electric Code Minimum Efficiency + Additional PV																

5 Reach Code Options

This section combines the cost effectiveness and compliance results across all three compliance metrics. The combined results below inform reach code policies to ensure an efficiency or electrification package can be built cost effectively while complying with 2022 Title24 code. The source energy margin is extracted directly from the software and is a comparison against the ACM standard design created by the software. The two TDV margins – efficiency compliance and total compliance – are calculated by subtraction against the mixed fuel baseline model because of software limitations that are beyond Reach Code Team's control.[3] The source energy margin however is extracted directly from the software and is a comparison against the ACM standard design created by the software. Full details of the compliance margin and cost effectiveness results are presented in Final Results Workbook.

The tables in the following sections show,

- "2" with **green** highlight for scenarios that are cost effective on both metrics and have positive compliance margin based on the metric specified in column heading.
- "1" with **yellow** highlight for scenarios that are cost effective on either one of the metrics and has positive compliance margin based on the metric specified in column heading.
- "1" with **grey** highlight for scenarios that are not cost effective on either metrics but have positive compliance margin based on the metric specified in column heading.
- "0" with no color highlight for scenarios that are not cost effective on either one of the metrics and have negative compliance margin based on the metric specified in column heading.

The package names in table results columns are as follows:

- Mixed fuel – EE: mixed fuel with energy efficiency package
- All Electric – HVAC: Electric HVAC
- All Electric – HVAC+SHW: Electric HVAC + Service Hot Water
- All Electric – HVAC+EE: All-electric HVAC with energy efficiency package
- All Electric – HVAC+EE+Load Flex: All-electric HVAC with energy efficiency and load flexibility package

Restaurant has two electrification scenarios, with and without cooking electrification,

- All Electric – HS+EE: Electric HVAC and SHW with energy efficiency package
- All Electric – HS+cook+EE: All-electric HVAC, SHW and cooking with energy efficiency package

Small Hotel has an extra package that evaluates a different HVAC type in all-electric model,

- All Electric – HVAC+SHW (PTHP): All-electric HVAC and SHW, where HVAC type is PTHP instead of SZHP proposed in Section 3.2.1 for other all-electric packages.

Jurisdictions are advised to adopt packages that shows green or yellow highlight (cost effective and compliant) across all three-compliance metrics. Jurisdictions could also adopt packages if the three compliance metrics show grey highlight (compliant but not cost effective) if they are looking to adopt without Energy Commission approval or amending Title 24 Part 6 Energy Code and do not need to justify cost impacts.

[3] The difference between the two methods of calculating TDV margins occurs due to various software limitations, mixed fuel baseline model not showing zero compliance, proposed electrification package and mixed fuel baseline model has different ACM standard design, and discrepancy between 2022 Title 24 code and software's standard design assumptions. Most scenarios show similar trends between software calculated compliance margin and manual subtraction against mixed fuel baseline model, with a difference in magnitude. For example, if the Total TDV Compliance margin as shown by software directly is negative, it is negative per manual calculation as well. Also, some scenarios have very low negative compliance margin and are very close to being zero.

5.1 Medium Office

For medium office, the Reach Code Team analyzed Energy Efficiency (EE) over mixed fuel baseline model and three electrification packages - HVAC, HVAC+EE and HVAC+EE+load-flexibility packages.

- Supports reach code adoption for energy efficiency measures over mixed fuel baseline.
-

Table 16. Cost Effectiveness and Compliance Summary – Medium office

CZ	Utility	Mixed Fuel			All Electric		
		EE			HVAC	HVAC + EE	HVAC + EE +Load Flex
		Eff Comp TDV	Tot Comp TDV	SrcE			
cz01	PG&E	2	2	2	Results for all-electric designs will be added in next version		
cz02	PG&E	2	2	2			
cz03	PG&E	2	2	2			
cz04	PG&E	2	2	2			
cz04-2	CPAU	2	2	2			
cz05	PG&E	2	2	2			
cz05-2	SCG	2	2	2			
cz06	SCE	2	2	2			
cz07	SDG&E	2	2	2			
cz08	SCE	2	2	2			
cz09	SCE	2	2	2			
cz10	SDG&E	2	2	2			
cz10-2	SCE	2	2	2			
cz11	PG&E	2	2	2			
cz12	PG&E	2	2	2			
cz12-2	SMUD	2	2	2			
cz13	PG&E	2	2	2			
cz14	SDG&E	2	2	2			
cz14-2	SCE	2	2	2			
cz15	SCE	2	2	2			
cz16	PG&E	2	2	2			

green	c/e+compliant
yellow	1 c/e +compliant
grey	compliant but not c/e

5.2 Medium Retail

For medium retail, the team analyzed Energy Efficiency (EE) over mixed fuel baseline model and two electrification packages - HVAC and HVAC+EE.

- Supports reach code adoption for energy efficiency measures over mixed fuel baseline.
- Supports all-electric reach code option, as it is compliant with added energy efficiency measures in climate zones 2-15.

Table 17. Cost Effectiveness and Compliance Summary – Medium Retail

CZ	Utility	Mixed Fuel			All Electric	
		EE			HVAC	HVAC + EE
		Eff Comp TDV	Comp TDV	SrcE		
cz01	PG&E	2	2	0	Results for all-electric designs will be added in next version	
cz02	PG&E	2	2	0		
cz03	PG&E	2	2	0		
cz04	PG&E	2	2	0		
cz04-2	CPAU	2	2	0		
cz05	PG&E	2	2	0		
cz05-2	SCG	2	2	0		
cz06	SCE	2	2	0		
cz07	SDG&E	2	2	2		
cz08	SCE	2	2	0		
cz09	SCE	2	2	2		
cz10	SDG&E	2	2	0		
cz10-2	SCE	2	2	0		
cz11	PG&E	2	2	0		
cz12	PG&E	2	2	0		
cz12-2	SMUD	2	2	0		
cz13	PG&E	2	2	0		
cz14	SDG&E	2	2	0		
cz14-2	SCE	2	2	0		
cz15	SCE	2	2	0		
cz16	PG&E	2	2	2		

green	c/e+compliant
yellow	1 c/e +compliant
grey	compliant but not c/e

5.3 Quick Service Restaurant (QSR)

For QSR, the team analyzed Energy Efficiency (EE) over mixed fuel baseline model and two sets of electrification packages, with and without cooking appliance electrification. For "HS" scenario including HVAC and SHW electrification only, packages with EE, EE+Load Flex and EE+PV was analyzed.

- Supports reach code adoption for energy efficiency measures over mixed fuel baseline in many climate zones.

Table 18. Cost Effectiveness and Compliance Summary – Quick Service Restaurant

CZ	Utility	Mixed Fuel			All-electric "HS" (HVAC+SHW)			
		EE			HS	HS +EE	HS +EE+ Load Flex	HS +EE+ PV
		Eff Comp TDV	Tot Comp TDV	SrcE				
cz01	PG&E	2	2	2	Results for all-electric designs will be added in next version			
cz02	PG&E	2	2	2				
cz03	PG&E	2	2	2				
cz04	PG&E	2	2	2				
cz04-2	CPAU	2	2	2				
cz05	PG&E	2	2	2				
cz05-2	SCG	2	2	2				
cz06	SCE	2	2	2				
cz07	SDG&E	2	2	2				
cz08	SCE	2	2	0				
cz09	SCE	2	2	0				
cz10	SDG&E	2	2	0				
cz10-2	SCE	2	2	0				
cz11	PG&E	2	2	0				
cz12	PG&E	2	2	0				
cz12-2	SMUD	2	2	0				
cz13	PG&E	2	2	2				
cz14	SDG&E	2	2	0				
cz14-2	SCE	2	2	0				
cz15	SCE	2	2	0				
cz16	PG&E	2	2	0				

green	c/e+compliant
yellow	1 c/e +compliant
grey	compliant but not c/e

The Reach Code Team analyzed a completely all-electric model including cooking appliance electrification,.

Figure 5. Cost Effectiveness and Compliance Summary – Quick Service Restaurant (with cooking)

CZ	Utility	All Electric		
		HVAC+SHW+cook	HVAC+SHW+cook + EE	HVAC+SHW+cook+EE +Load Flex
cz01	PG&E	Results for all-electric designs will be added in next version		
cz02	PG&E			
cz03	PG&E			
cz04	PG&E			
cz04-2	CPAU			
cz05	PG&E			
cz05-2	SCG			
cz06	SCE			
cz07	SDG&E			
cz08	SCE			
cz09	SCE			
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			

green	c/e+compliant
yellow	1 c/e +compliant
grey	compliant but not c/e

5.4 Small Hotel

For small hotel, the team analyzed Energy Efficiency (EE) over mixed fuel baseline model and four electrification packages - HVAC+SHW, HVAC+SHW+EE, HVAC+SHW+EE+LoadFlex and HVAC+SHW+EE+AddPV.

- Supports reach code adoption for energy efficiency measures over mixed fuel baseline in many climate zones.
-

Table 19. Cost Effectiveness and Compliance Summary – Small Hotel

CZ	Utility	Mixed Fuel			All Electric		
		EE			HVAC + SHW	HVAC + SHW + EE	HVAC + SHW + EE + AddPV
		Eff Comp TDV	Tot Comp TDV	SrcE			
cz01	PG&E	2	2	2	Results for all-electric designs will be added in next version		
cz02	PG&E	2	2	2			
cz03	PG&E	2	2	2			
cz04	PG&E	2	2	2			
cz04-2	CPAU	2	2	2			
cz05	PG&E	2	2	2			
cz05-2	SCG	2	2	2			
cz06	SCE	2	2	2			
cz07	SDG&E	2	2	2			
cz08	SCE	2	2	2			
cz09	SCE	2	2	2			
cz10	SDG&E	2	2	2			
cz10-2	SCE	2	2	2			
cz11	PG&E	2	2	2			
cz12	PG&E	2	2	2			
cz12-2	SMUD	2	2	2			
cz13	PG&E	2	2	2			
cz14	SDG&E	2	2	2			
cz14-2	SCE	2	2	2			
cz15	SCE	2	2	2			
cz16	PG&E	2	2	2			

green	c/e+compliant
yellow	1 c/e +compliant
grey	compliant but not c/e

- The Team analyzed an additional scenario that proposes PTHP compared to the same SZAC mixed fuel baseline model.

Figure 6. Cost Effectiveness and Compliance Summary – Small Hotel (PTHP)

CZ	Utility	All Electric		
		HVAC + SHW (PTHP)		
		Eff Comp TDV	Tot Comp TDV	SrcE
cz01	PG&E	Results for all-electric designs will be added in next version		
cz02	PG&E			
cz03	PG&E			
cz04	PG&E			
cz04-2	CPAU			
cz05	PG&E			
cz05-2	SCG			
cz06	SCE			
cz07	SDG&E			
cz08	SCE			
cz09	SCE			
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			

green	c/e+compliant
yellow	1 c/e +compliant
grey	compliant but not c/e

6 Conclusions

The Reach Codes Team developed packages of energy efficiency measures as well as packages combining energy efficiency with load flexibility measures, simulated them in building modeling software, and gathered costs to determine the cost-effectiveness of multiple scenarios. The Reach Codes Team coordinated assumptions 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, costs, energy escalation rates, software version or utility tariffs are likely to change results.

These results, including the attached workbook, indicate high potential for mixed fuel plus efficiency and/or all-electric policy adoption in a wide range of California jurisdictions. It is important to note that the Reach Code Team employed several CBECC ruleset modifications to achieve cost-effective packages. Where jurisdictions want to encourage the adoption of Load Flexibility measures through modeling estimates, the Reach Code Team can suggest the usage of modeling approximations that may achieve similar energy and compliance total impacts, in coordination with the Energy Commission.

6.1 Limitations and Further Considerations

We encountered some modeling limitations, outside of the Team's control and challenges that should be noted while using these results to inform reach code policies,

- CBECC Software: The Reach Code Team coordinated with the 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.
- Prototype Building: The cost-effective 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 Reach Code team has worked in coordination with the software development team to inform future software versions or apply a workaround in current analysis. The assumptions related to prototype characteristics and system costs should be kept in mind while adopting reach codes based on this analysis.

In addition to the packages assessed in the report, there are future potential enhancements 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.
- Added energy efficiency measures as software capability evolves such as drain water heat recovery.
- Applying federally pre-emptive (high) efficiency energy systems or appliances.

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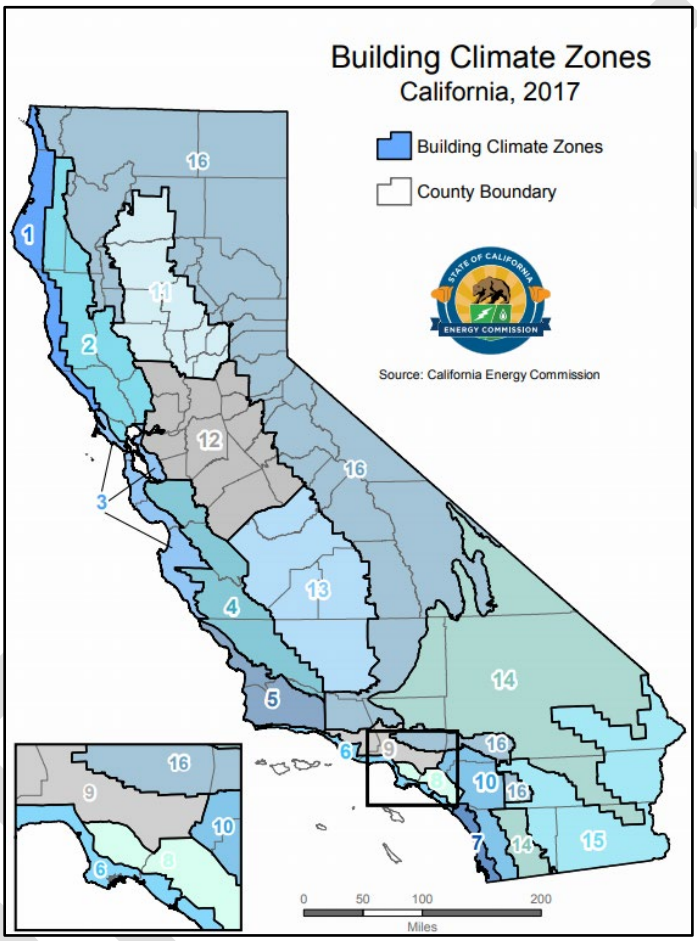
8 Appendices

8.1 Map of California CZs

Climate Zone geographical boundaries are depicted in Figure 7 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 7. 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 20. 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/PG&E**	E-2	E-2	E-2	E-2	G-NR1
CZ05	**PG&E**	B-10	B-1	B-1	B-1 or B-10	G-NR1
CZ05-2	**PG&E/SCG**	B-10	B-1	B-1	B-1 or B-10	G-10 (GN-10)
CZ06	**SCE/SCG**	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/SCG**	TOU-GS-2	TOU-GS-2	TOU-GS-2	TOU-GS-2	G-10 (GN-10)
CZ09	**SCE/SCG**	TOU-GS-2	TOU-GS-2	TOU-GS-2	TOU-GS-2	G-10 (GN-10)
CZ10	**SCE/SCG**	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	**SDG&E**	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-10	B-1 or B-10	B-10	G-NR1
CZ12-2	**SMUD/PG&E**	CITS-1 (CI-TOD 1)	CITS-1 (CI-TOD 1)	CITS-1 (CI-TOD 1)	CITS	G-NR1
CZ13	**PG&E**	B-10	B-10	B-1 or B-10	B-10	G-NR1
CZ14	**SCE/SCG**	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	**SDG&E**	TOU-GS-2	TOU-GS-2	TOU-GS-2	TOU-GS-2	GN-3
CZ15	**SCE/SCG**	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

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Cancelling Revised Cal. P.U.C. Sheet No. 52618-E
Revised Cal. P.U.C. Sheet No. 52337-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.

Time-of-Use Rates	B-1 Rates		B1-ST Rates	
Total Customer Charge Rates				
Customer Charge Single-phase ($ per meter per day)	$0.32854		$0.32854	
Customer Charge Poly-phase ($ per meter per day)	$0.82136		$0.82136	
Demand Charge (for B1-ST only) Total Demand Rate (per metered kW/month assessed from 2:00 p.m. to 11:00 p.m. only)				
Summer	—		$4.60	(R)
Winter	—		$4.60	(R)
Total TOU Energy Rates ($ per kWh)				
Peak Summer	$0.38551	(I)	$0.44683	(I)
Part-Peak Summer	$0.33628	(I)	$0.30553	(I)
Off-Peak Summer	$0.31547	(I)	$0.25820	(I)
Peak Winter	$0.31009	(I)	$0.34888	(I)
Partial-Peak Winter (for B1-ST only)	—		$0.31938	(I)
Off-Peak Winter	$0.29397	(I)	$0.23033	(I)
Super Off-Peak Winter	$0.27755	(I)	$0.21391	(I)
PDP Rates (Consecutive Day and Five-Hour Event Option)*				(T)
PDP Charges ($ per kWh) All Usage During PDP Event	$0.60			
PDP Credits Energy ($ per kWh) Peak Summer	($0.05667)	(R)		
Part-Peak Summer	($0.01683)	(R)		

* See PDP Detail, section g, for corresponding reduction in PDP credits and charges if other option(s) elected.

(Continued)

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Pacific Gas and Electric Company®
San Francisco, California
U 39

Revised Cal. P.U.C. Sheet No. 52621-E
Cancelling Revised Cal. P.U.C. Sheet No. 52340-E

ELECTRIC SCHEDULE B-10 Sheet 3
MEDIUM GENERAL DEMAND-METERED SERVICE

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 RATES Secondary Voltage		Primary Voltage		Transmission Voltage	
Total Customer/Meter Charge Rates						
Customer Charge ($ per meter per day)	$5.91042	(I)	$5.91042	(I)	$5.91042	(I)
Total Demand Rates ($ per kW)						
Summer	$16.96	(I)	$16.73	(I)	$13.13	
Winter	$16.96	(I)	$16.73	(I)	$13.13	
Total Energy Rates ($ per kWh)						
Peak Summer	$0.31297	(I)	$0.29542	(I)	$0.22689	(I)
Part-Peak Summer	$0.25128	(I)	$0.23712	(I)	$0.17015	(I)
Off-Peak Summer	$0.21871	(I)	$0.20628	(I)	$0.14008	(I)
Peak Winter	$0.23670	(I)	$0.22256	(I)	$0.17384	(I)
Off-Peak Winter	$0.20122	(I)	$0.18893	(I)	$0.14100	(I)
Super Off-Peak Winter	$0.16488	(I)	$0.15259	(I)	$0.10466	(I)
PDP Rates (Consecutive Day and Five-Hour Event Option						(T)
PDP Charges ($ per kWh)						
All Usage During PDP Event	$0.90		$0.90		$0.90	
PDP Credits						
Energy ($ per kWh)						
Peak Summer	($0.07825)	(R)	($0.07825)	(R)	($0.07825)	(R)
Part-Peak Summer	($0.02710)	(R)	($0.02710)	(R)	($0.02710)	(R)

* See PDP Details, section g, for corresponding reduction in PDP credits and charges if other option(s) elected.

(Continued)

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GAS SCHEDULE G-NR1 Sheet 2
GAS SERVICE TO SMALL COMMERCIAL CUSTOMERS

RATES (CON'T):

	ADU (Therms)				
	0 – 5.0	5.1 to 16.0	16.1 to 41.0	41.1 to 123.0	123.1 & Up
Customer Charge: (per day)	$0.27048	$0.52106	$0.95482	$1.66489	$2.14936

	Per Therm							
	Summer				Winter			
	First 4,000 Therms		Excess		First 4,000 Therms		Excess	
Procurement Charge:	$0.59465	(R)	$0.59465	(R)	$0.59465	(R)	$0.59465	(R)
Transportation Charge:	$0.90750		$0.56273		$1.06734		$0.66184	
Total:	$1.50215	(R)	$1.15738	(R)	$1.66199	(R)	$1.25649	(R)

Cap-and-Trade Cost Exemption (per therm): $0.10234

8.2.2 SCE

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Southern California Edison — Revised Cal. PUC Sheet No. 73172-E
Rosemead, California (U 338-E) — Cancelling Revised Cal. PUC Sheet No. 72694-E

Schedule TOU-GS-1 — Sheet 5
TIME-OF-USE
GENERAL SERVICE
(Continued)

RATES (Continued)

Option D	Delivery Service								Generation**	
	Trans1	Distrbtn2	NSGC3	NDC4	PPPC5	DWRBC6	PUCRF7	Total8	UG**	DWREC10
Energy Charge - $/kWh										
Summer Season On-Peak	0.00087	0.04765 (I)	0.01012 (R)	0.00010	0.01787 (R)	0.00652	0.00130	0.08443 (I)	0.11278 (I)	0.00000
Mid-Peak	0.00087	0.04765 (I)	0.01012 (R)	0.00010	0.01787 (R)	0.00652	0.00130	0.08443 (I)	0.10220 (I)	0.00000
Off-Peak	0.00087	0.01246 (I)	0.01012 (R)	0.00010	0.01787 (R)	0.00652	0.00130	0.04924 (R)	0.06840 (I)	0.00000
Winter Season										
Mid-Peak	0.00087	0.04765 (I)	0.01012 (R)	0.00010	0.01787 (R)	0.00652	0.00130	0.08443 (I)	0.10837 (I)	0.00000
Off-Peak	0.00087	0.01246 (I)	0.01012 (R)	0.00010	0.01787 (R)	0.00652	0.00130	0.04924 (R)	0.07600 (I)	0.00000
Super-Off-Peak	0.00087	0.00735 (I)	0.01012 (R)	0.00010	0.01787 (R)	0.00652	0.00130	0.04413 (R)	0.05721 (I)	0.00000
Customer Charge - $/day		0.595 (I)						0.595 (I)		
Facilities Related Demand Charge - $/kW	3.81	11.04 (I)						14.85 (I)		
Time Related Demand Charge - $/kW										
Summer Season										
On-Peak		4.73 (I)						4.73 (I)	17.48 (I)	
Winter Season										
Mid-peak - Weekdays (4-9pm)		0.00						0.00	4.06 (I)	
Three-Phase Service - $/day		0.031						0.031		
Voltage Discount, Energy - $/kWh										
From 2 kV to 50 kV	0.00000	(0.00029)						(0.00029)	(0.00102) (I)	
From 51 kV to 219 kV	0.00000	(0.00376) (I)						(0.00376) (I)	(0.00190) (I)	
220 kV and above	0.00000	(0.02104) (I)						(0.02104) (I)	(0.00193) (I)	
Voltage Discount, Demand - $/kW										
Facilities Related										
From 2 kV to 50 kV	0.00	(0.15) (I)						(0.15) (I)		
Above 50 kV but below 220 kV	0.00	(8.37) (I)						(8.37) (I)		
At 220 kV	0.00	(11.04) (I)						(11.04) (I)		
Voltage Discount, Summer On Peak Demand (Distribution) - $/kW										
From 2 kV to 50 kV		(0.04)						(0.04)		
Above 50 kV but below 220 kV		(1.17) (I)						(1.17) (I)		
At 220 kV		(2.83) (I)						(2.83) (I)		
Voltage Disc, Summer On Peak and Winter Weekdays (4-9pm) Demand (URG) - $/kW										
From 2 kV to 50 kV									(0.14)	
Above 50 kV but below 220 kV									(0.38)	
At 220 kV									(0.38)	
California Alternate Rates for Energy Discount - %		100.00*						100.00*		
California Climate Credit - $/kWh		(59.00) (I)						(59.00) (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)

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 $0.00315 per kWh

2 Distrbtn = 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 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 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.

(Continued)

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SOUTHERN CALIFORNIA EDISON
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Rosemead, California (U 338-E) — Cancelling Revised Cal. PUC Sheet No. 72706-E

Schedule TOU-GS-2 Sheet 4
TIME-OF-USE - GENERAL SERVICE - DEMAND METERED

(Continued)

RATES (Continued)

Option D / Option D-CPP	Delivery Service								Generation*	
	Trans[1]	Distrbtn[2]	NSGC[3]	NDC[4]	PPPC[5]	DWRBC[6]	PUCRF[7]	Total[8]	UG**	DWREC[10]
TOU Pricing										
Energy Charge - $/kWh/Meter/Month										
Summer Season - On-Peak	0.00114	0.01144 (I)	0.00963 (R)	0.00010	0.01823 (I)	0.00652	0.00130	0.04836 (I)	0.11160 (I)	0.00000
Mid-Peak	0.00114	0.01144 (I)	0.00963 (R)	0.00010	0.01823 (I)	0.00652	0.00130	0.04836 (I)	0.10035 (I)	0.00000
Off-Peak	0.00114	0.01144 (I)	0.00963 (R)	0.00010	0.01823 (I)	0.00652	0.00130	0.04836 (I)	0.06525 (I)	0.00000
Winter Season - Mid-Peak	0.00114	0.01144 (I)	0.00963 (R)	0.00010	0.01823 (I)	0.00652	0.00130	0.04836 (I)	0.08572 (I)	0.00000
Off-Peak	0.00114	0.01144 (I)	0.00963 (R)	0.00010	0.01823 (I)	0.00652	0.00130	0.04836 (I)	0.07196 (I)	0.00000
Super-Off-Peak	0.00114	0.01144 (I)	0.00963 (R)	0.00010	0.01823 (I)	0.00652	0.00130	0.04836 (I)	0.04610 (I)	0.00000
Customer Charge - $/Meter/Month		206.87 (I)						206.87 (I)		
Facilities Related Demand Charge - $/kW	5.14	12.43 (I)						17.57 (I)		
Time Related Demand Charge - Summer Season - $/kW										
On-Peak		15.50 (I)						15.50 (I)	23.56 (I)	
Winter Season - $/kW										
Mid-peak - Weekdays (4-9pm)		5.56 (I)						5.56 (I)	4.78 (I)	
Single Phase Service - $/Month		(11.46) (R)						(11.46) (R)		
Voltage Discount, Demand - $/kW										
Facilities Related										
From 2 kV to 50 kV	0.00	(0.17) (I)						(0.17) (I)	0.00	
Above 50 kV but below 220 kV	0.00	(7.17) (I)						(7.17) (I)	0.00	
At 220 kV	0.00	(12.43) (I)						(12.43) (I)	0.00	
Summer On Peak and Winter Weekdays (4-9pm) Demand - $/kW										
From 2 kV to 50 kV	0.00	(0.14) (I)						(0.14) (I)	(0.18) (I)	
Above 50 kV but below 220 kV	0.00	(3.85) (I)						(3.85) (I)	(0.50) (I)	
At 220 kV	0.00	(9.27) (I)						(9.27) (I)	(0.50) (I)	
Voltage Discount, Energy - $/kWh										
From 2 kV to 50 kV	0.00000	(0.00014) (I)						(0.00014) (I)	(0.00105) (I)	
Above 50 kV but below 220 kV	0.00000	(0.00418) (I)						(0.00418) (I)	(0.00234) (I)	
At 220 kV	0.00000	(0.01010) (I)						(0.01010) (I)	(0.00235) (I)	
California Alternate Rates for Energy Discount - %		100.00*						100.00*		
TOU Option Meter Charge - $/Meter/Month		28.84 (I)						28.84 (I)		
RTEM										
California Climate Credit - $/kWh		(59.00) (I)						(59.00) (I)		
Option D-CPP										
CPP Event Energy Charge - $/kWh									0.80000	
Summer CPP Non-Event Credit On-Peak Demand Credit - $/kW									(6.85)	
Maximum Available Credit - $/kW***										
Summer Weekdays (4-9pm)									(23.56) (I)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
** The ongoing Competition Transition Charge (CTC) of $(0.00016) 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 $(.00141) per kWh, Reliability Services Balancing Account Adjustment (RSBAA) of $(0.00060) per kWh, and Transmission Access Charge Balancing Account Adjustment (TACBAA) of $0.00315 per kWh.
2 Distrbtn = 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 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 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.

(Continued)

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SOUTHERN CALIFORNIA EDISON
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Southern California Edison — Revised Cal. PUC Sheet No. 73208-E
Rosemead, California (U 338-E) — Cancelling Revised Cal. PUC Sheet No. 72721-E

Schedule TOU-GS-3 — Sheet 3
TIME-OF-USE - GENERAL SERVICE - DEMAND METERED

(Continued)

RATES (Continued)

	Delivery Service								Generation[9]	
	Trans[1]	Distribtn[2]	NSGC[3]	NDC[4]	PPPC[5]	DWRBC[6]	PUCRF[7]	Total[8]	UG**	DWREC[10]
Option D / Option D-CPP										
Energy Charge - $/kWh/Meter/Month										
Summer Season - On-Peak	0.00095	0.00998 (I)	0.00888 (R)	0.00010	0.01771 (R)	0.00652	0.00130	0.04540 (R)	0.10353 (I)	0.00000
Mid-Peak	0.00095	0.00998 (I)	0.00888 (R)	0.00010	0.01771 (R)	0.00652	0.00130	0.04540 (R)	0.09309 (I)	0.00000
Off-Peak	0.00095	0.00998 (I)	0.00888 (R)	0.00010	0.01771 (R)	0.00652	0.00130	0.04540 (R)	0.08120 (I)	0.00000
Winter Season										
Mid-Peak	0.00095	0.00998 (I)	0.00888 (R)	0.00010	0.01771 (R)	0.00652	0.00130	0.04540 (R)	0.08038 (I)	0.00000
Off-Peak	0.00095	0.00998 (I)	0.00888 (R)	0.00010	0.01771 (R)	0.00652	0.00130	0.04540 (R)	0.06747 (I)	0.00000
Super-Off-Peak	0.00095	0.00998 (I)	0.00888 (R)	0.00010	0.01771 (R)	0.00652	0.00130	0.04540 (R)	0.04329 (I)	0.00000
Customer Charge - $/Meter/Month		496.98 (I)						496.98 (I)		
Demand Charge - $/kW of Billing Demand/Meter/Month										
Facilities Related	5.65	13.29 (I)						18.94 (I)		
Time Related										
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)	4.06 (I)	
Voltage Discount, Demand - $/kW										
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)		
Voltage Discount, Summer On Peak and Winter Weekdays (4-9pm) Demand - $/kW										
From 2 kV to 50 kV	0.00	(0.13)						(0.13)	(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)	
Voltage Discount, Energy - $/kWh										
From 2 kV to 50 kV	0.00000	(0.00013)						(0.00013)	(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)	(0.00230) (I)	
Power Factor Adjustment - $/kVAR										
Greater than 50 kV		0.54						0.54		
50 kV or less		0.60						0.60		
California Alternate Rates for Energy Discount - %		100.00*						100.00*		
Option D-CPP										
CPP Event Energy Charge - $/kWh									0.80000	
Summer CPP Non-Event Credit On-Peak Demand Credit - $/kW									(7.55)	
Maximum Available Credit - $/kW***										
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 Distribtn = 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 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.

(Continued)

(To be inserted by utility)
Advice 4719-E
Decision

Issued by
Michael Backstrom
Vice President

(To be inserted by Cal. PUC)
Date Submitted Feb 15, 2022
Effective Mar 1, 2022
Resolution

3C7

8.2.3 SCG

SOUTHERN CALIFORNIA GAS COMPANY Revised CAL. P.U.C. SHEET NO. 59656-G
LOS ANGELES, CALIFORNIA CANCELING Revised CAL. P.U.C. SHEET NO. 59617-G

Schedule No. G-10 Sheet 2
CORE COMMERCIAL AND INDUSTRIAL SERVICE
(Includes GN-10, GN-10C and GT-10 Rates)
(Continued)

RATES (Continued)

All Procurement, Transmission, and Commodity Charges are billed per therm.

			Tier I[1/]	Tier II[1/]	Tier III[1/]	
GN-10:[4/]	Applicable to natural gas procurement service to non-residential core customers, including service not provided under any other rate schedule.					
	Procurement Charge:[2/]	G-CPNR	55.921¢	55.921¢	55.921¢	
	Transmission Charge:	GPT-10	106.047¢	60.635¢	30.186¢	
	Commodity Charge:	GN-10	161.968¢	116.556¢	86.107¢	
GN-10C[4/]:	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:[2/]	G-CPNRC	55.921¢	55.921¢	55.921¢	R,R,R
	Transmission Charge:	GPT-10	106.047¢	60.635¢	30.186¢	
	Commodity Charge:	GN-10C	161.968¢	116.556¢	86.107¢	R,R,R
GT-10[4/]:	Applicable to non-residential transportation-only service including CAT service, as set forth in Special Condition 13.					
	Transmission Charge:	GT-10	106.047¢[3/]	60.635¢[3/]	30.186¢[3/]	

[1/] 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.

[2/] 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.

[3/] 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. 5948
DECISION NO.
2C6

ISSUED BY
Dan Skopec
Vice President
Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)
SUBMITTED Mar 4, 2022
EFFECTIVE Mar 10, 2022
RESOLUTION NO. G-3351

8.2.4 SDG&E

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 35757-E
Canceling Revised Cal. P.U.C. Sheet No. 35366-E

SCHEDULE TOU-A Sheet 2

GENERAL SERVICE - TIME OF USE SERVICE

RATES*

Description TOU-A	Transm	Distr	PPP	ND	CTC	LGC	RS	TR	UDC Total
Basic Service Fee ($/mo)									
Secondary									
0-5 kW		10.70							10.70
>5-20 kW		17.12							17.12
>20-50 kW		32.10							32.10
>50 kW		80.25							80.25
Primary									
0-5 kW		10.70							10.70
>5-20 kW		17.12							17.12
>20-50 kW		32.10							32.10
>50 kW		80.25							80.25
Energy Charges ($/kWh)									
Summer									
On-Peak:									
Secondary	0.03967 I	0.12441 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18791 I
Primary	0.03967 I	0.12378 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18728 I
Off-Peak:									
Secondary	0.03967 I	0.12441 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18791 I
Primary	0.03967 I	0.12378 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18728 I
Winter									
On-Peak:									
Secondary	0.03967 I	0.12441 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18791 I
Primary	0.03967 I	0.12378 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18728 I
Off-Peak									
Secondary	0.03967 I	0.12441 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18791 I
Primary	0.03967 I	0.12378 I	0.01995 I	0.00007	0.00107 I	0.00273 R	0.00001 I		0.18728 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. PPP energy charges includes Low Income PPP rate (LI-PPP) $0.01059/kWh, Non-low Income PPP rate (Non-LI-PPP) $0.00332/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 $0.00570/kWh, California Solar Initiative rate (CSI) $0.00000/kWh, and Self-Generation Incentive Program rate (SGIP) $0.00035/kWh. R, R I I I R

SCHEDULE EECC-TOU-A-P

Sheet 2

ELECTRIC COMMODITY COST
TIME OF USE PLUS

RATES*

RYU Event Period Adder – TOU-A-P	($/kWh)	
Secondary	1.17	
Primary	1.16	
TOU Energy Charges	**($/kWh)**	
On-Peak – Summer		
Secondary	0.21936	I
Primary	0.21827	I
Off-Peak – Summer		
Secondary	0.12044	I
Primary	0.11984	I
On-Peak – Winter		
Secondary	0.16307	I
Primary	0.16230	I
Off-Peak – Winter		
Secondary	0.07996	I
Primary	0.07966	I

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 35768-E
Canceling Revised Cal. P.U.C. Sheet No. 35375-E

SCHEDULE AL-TOU

Sheet 3

GENERAL SERVICE - TIME METERED

RATES* (Continued)

Description – AL-TOU	Transm		Distr		PPP		ND	CTC		LGC	RS	TRAC	UDC Total	
Demand Charges ($/kW)														
Non-Coincident														
Secondary	18.63	I	11.26	I				0.00			0.00		29.89	I
Primary	18.00	I	11.20	I				0.00			0.00		29.20	I
Secondary Substation	18.63	I	0.22	R	0.52	I		0.36	I		0.00		19.73	I
Primary Substation	18.00	I	0.22	R	0.52	I		0.36	I		0.00		19.10	I
Transmission	17.93	I	0.22	R	0.52	I		0.36	I		0.00		19.03	I
Maximum On-Peak														
Summer														
Secondary	3.90	I	21.18	I									25.08	I
Primary	3.77	I	21.06	I									24.83	I
Secondary Substation	3.90	I	0.00										3.90	I
Primary Substation	3.77	I	0.00										3.77	I
Transmission	3.75	I	0.00										3.75	I
Winter														
Secondary	0.82	I	24.74	I									25.56	I
Primary	0.79	I	24.62	I									25.41	I
Secondary Substation	0.82	I	0.00										0.82	I
Primary Substation	0.79	I	0.00										0.79	I
Transmission	0.79	I	0.00										0.79	I
Power Factor ($/kvar)														
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	

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 35858-E
Canceling Revised Cal. P.U.C. Sheet No. 35438-E

SCHEDULE EECC

Sheet 5

ELECTRIC ENERGY COMMODITY COST

Commodity Rates (Continued)

Schedule A-TC	($/kWh)	
Summer	0.08484	I
Winter	0.08484	I
Schedule TOU-M		
Summer		
On-Peak Energy	0.35576	I
Off-Peak Energy	0.12137	I
Super Off-Peak Energy	0.06813	I
Winter		
On-Peak Energy	0.14143	I
Off-Peak Energy	0.07956	I
Super Off-Peak Energy	0.06146	I
Schedule OL-TOU		
Summer		
On-Peak Energy	0.42632	I
Off-Peak Energy	0.14501	R
Super Off-Peak Energy	0.07977	I
Winter		
On-Peak Energy	0.16754	I
Off-Peak Energy	0.09390	I
Super Off-Peak Energy	0.07254	I
Schedule AL-TOU	($/kW)	
Maximum On-Peak Demand: Summer		
Secondary	12.68	I
Primary	12.62	I
Secondary Substation	12.68	I
Primary Substation	12.62	I
Transmission	12.08	I
Maximum On-Peak Demand: Winter		
Secondary		
Primary		
Secondary Substation		
Primary Substation		
Transmission		
On-Peak Energy: Summer	($/kWh)	
Secondary	0.18610	I
Primary	0.18520	I
Secondary Substation	0.18610	I
Primary Substation	0.18520	I
Transmission	0.17727	I
Off-Peak Energy: Summer		
Secondary	0.10857	R
Primary	0.10807	R
Secondary Substation	0.10857	R
Primary Substation	0.10807	R
Transmission	0.10346	R
Super Off-Peak Energy: Summer		
Secondary	0.10372	I
Primary	0.10337	I
Secondary Substation	0.10372	I
Primary Substation	0.10337	I
Transmission	0.09920	I

(Continued)

5C8
Advice Ltr. No. 3928-E
Decision No.

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Submitted Dec 30, 2021
Effective Jan 1, 2022
Resolution No.

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 35859-E
Canceling Revised Cal. P.U.C. Sheet No. 35439-E

SCHEDULE EECC

Sheet 6

ELECTRIC ENERGY COMMODITY COST

RATES (Continued)
Commodity Rates (Continued)

Schedule AL-TOU – (Continued)		
On-Peak Energy: Winter		
Secondary	0.21780	I
Primary	0.21680	I
Secondary Substation	0.21780	I
Primary Substation	0.21680	I
Transmission	0.20766	I
Off-Peak Energy: Winter		
Secondary	0.12207	I
Primary	0.12157	I
Secondary Substation	0.12207	I
Primary Substation	0.12157	I
Transmission	0.11657	I
Super Off-Peak Energy: Winter		
Secondary	0.09432	I
Primary	0.09401	I
Secondary Substation	0.09432	I
Primary Substation	0.09401	I
Transmission	0.09022	I
Schedule AL-TOU-2	**($/kW)**	
Maximum On-Peak Demand – Summer		
Secondary	23.48	I
Primary	23.37	I
Secondary Substation	23.48	I
Primary Substation	23.37	I
Transmission	22.37	I
Maximum On-Peak Demand: Winter	**($/kW)**	
Secondary	0.00	
Primary	0.00	
Secondary Substation	0.00	
Primary Substation	0.00	
Transmission	0.00	
On-Peak Energy: Summer	**($/kWh)**	
Secondary	0.16768	I
Primary	0.16688	I
Secondary Substation	0.16768	I
Primary Substation	0.16688	I
Transmission	0.15973	I
Off-Peak Energy - Summer		
Secondary	0.09754	R
Primary	0.09709	R
Secondary Substation	0.09754	R
Primary Substation	0.09709	R
Transmission	0.09296	R

(Continued)

6C7
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Decision No.

Issued by
Dan Skopec
Vice President
Regulatory Affairs

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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. T

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. N T

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.

RATES	GN-3	GN-3-C	GTC/GTCA
Customer charges, $ per meter per month:	$10.00	$10.00	$10.00

D

(Continued)

1C11
Advice Ltr. No. 1980-G
Decision No.

Issued by
Lee Schavrien
Senior Vice President
Regulatory Affairs

Date Filed Oct 15, 2010
Effective Nov 14, 2010
Resolution No.

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 25843-G
Canceling Revised Cal. P.U.C. Sheet No. 25826-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[2]
Procurement Charge (0 to 1,000)	$0.55988	$0.55988	R	N/A
Transportation Charge	$0.72856	$0.72856		$0.72858
Total Charge	$1.28844	$1.28844	R	$0.72858
Procurement Charge (1,001 to 21,000	$0.55988	$0.55988	R	N/A
Transportation Charge	$0.48510	$0.48510		$0.48512
Total Charge	$1.04498	$1.04498	R	$0.48512
Procurement Charge (Over 21,000	$0.55988	$0.55988	R	N/A
Transportation Charge	$0.41632	$0.41632		$0.41634
Total Charge	$0.97620	$0.97620	R	$0.41634

[2] 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)

8.2.5 City of Palo Alto Utilities

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:

Per kilowatt-hour (kWh)	Commodity	Distribution	Public Benefits	Total
Summer Period	$0.11855	$0.08551	$0.00447	$0.20853
Winter Period	0.08502	0.05675	0.00447	0.14624
Minimum Bill ($/day)				0.8359

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 7-1-2018

CITY OF PALO ALTO UTILITIES

Sheet No E-2-1
Effective 7-1-2019

CITY OF PALO ALTO UTILITIES

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 Sacramento Municipal Utilities District (Electric Only)

Commercial & Industrial Time-of-Day Rate Schedule CI-TOD1

C. Restructured Commercial & Industrial Time-of-Day Rates

	Effective as of October 1, 2021	Effective as of March 1, 2022	Effective as of January 1, 2023
CITS-0: C&I Secondary 0-20 kW			
Non-Summer Season (October - May)			
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	$0.1364
Off-Peak Saver *$/kWh*	$0.1373	$0.1394	$0.1323
Summer Season (June - September)			
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
CITS-1: C&I Secondary 21-299 kW			
Non-Summer Season (October - May)			
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	$0.1158
Off-Peak Saver *$/kWh*	$0.1078	$0.1094	$0.1030
Summer Season (June - September)			
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.

SACRAMENTO MUNICIPAL UTILITY DISTRICT
Resolution No. 21-09-06 adopted September 16, 2021

Sheet No. **CI-TOD1-3**
Effective: **September 17, 2021**
Edition: **September 17, 2021**

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 21 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 21. 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 22 shows the material and labor adjustment factors used to determine the costs.

Table 22. 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
CZ 13	1.000	0.990
CZ 14	0.964	0.980
CZ 15	0.963	0.996
CZ 16	0.967	0.990

Table 23 shows the contractor markup values used to determine the costs.

Table 23. Contractor Markup Values

	Contractor 1	Contractor 2
General Conditions and Overhead	15%	20%
Design and Engineering	5%	10%
Permit, testing and inspection	5%	3%
Contractor Profit/Market Factor	10%	10%

8.4 Mixed Fuel Baseline Figures

Table 24. Mixed Fuel Baseline Model – Medium Office

Climate zone	Utility	Annual Electricity Consumption (kWh)	Annual Natural Gas Consumption (therms)	Total kTDV/ft2	Total Compliance kTDV/ft2	Efficiency Compliance kTDV/ft2	GHG Emissions	Total Compliance Margin
CZ01	PG&E	186,894	5,331	130	10	72	63	1
CZ02	PG&E	163,979	3,253	142	12	107	52	2
CZ03	PG&E	176,640	2,672	131	5	83	48	1
CZ04	PG&E	163,768	2,003	125	(2)	107	46	1
CZ05	PG&E	170,544	2,575	113	(8)	76	46	1
CZ06	SCE	163,722	1,066	122	(7)	76	39	0
CZ07	SDG&E	169,611	747	114	(9)	76	38	0
CZ08	SCE	191,703	941	130	(2)	76	41	1
CZ09	SCE	169,514	1,119	135	0	76	41	1
CZ10	SDG&E	185,682	1,445	141	10	76	45	2
CZ11	PG&E	209,343	3,309	166	40	136	59	2
CZ12	PG&E	178,461	2,864	145	19	118	53	2
CZ13	PG&E	211,193	2,377	165	37	139	55	2
CZ14	SDG&E	156,689	3,058	147	13	139	52	3
CZ15	SCE	209,720	662	161	32	139	47	2
CZ16	PG&E	177,562	5,799	127	9	94	67	4

Table 25. Mixed Fuel Baseline Model – Medium Retail

Climate zone	Utility	Annual Electricity Consumption (kWh)	Annual Natural Gas Consumption (therms)	Total kTDV/ft2	Total Compliance kTDV/ft2	Efficiency Compliance kTDV/ft2	GHG Emissions	Total Compliance Margin
CZ01	PG&E	113,044	1,169	167	84	137	30	-4
CZ02	PG&E	119,731	1,600	217	130	204	34	-19

CZ03	PG&E	104,117	1,186	180	95	161	30	-5
CZ04	PG&E	116,941	962	203	116	198	30	-7
CZ05	PG&E	101,798	1,007	160	77	147	28	-7
CZ06	SCE	110,394	432	179	93	147	25	-12
CZ07	SDG&E	106,320	333	172	88	147	25	-3
CZ08	SCE	129,319	423	201	113	147	28	-14
CZ09	SCE	123,447	495	199	111	147	28	-6
CZ10	SDG&E	111,626	725	180	94	147	28	--
CZ11	PG&E	133,603	1,764	238	152	227	37	-10
CZ12	PG&E	131,670	1,514	228	143	219	36	-8
CZ13	PG&E	146,268	1,355	253	167	245	37	-19
CZ14	SDG&E	132,235	1,434	222	134	245	35	-9
CZ15	SCE	142,000	310	241	155	245	30	-23
CZ16	PG&E	113,857	3,537	197	118	188	45	-6

Table 26. Mixed Fuel Baseline Model – Quick Service Restaurant

Climate zone	Utility	Annual Electricity Consumption (kWh)	Annual Natural Gas Consumption (therms)	Total kTDV/ft2	Total Compliance kTDV/ft2	Efficiency Compliance kTDV/ft2	GHG Emissions	Total Compliance Margin
CZ01	PG&E	63,187	12,237	1,974	820	820	80	5
CZ02	PG&E	66,343	11,170	1,989	839	839	74	20
CZ03	PG&E	67,877	10,605	1,922	769	769	71	1
CZ04	PG&E	77,615	10,277	2,062	910	910	71	-4
CZ05	PG&E	69,442	10,655	1,898	744	744	71	-2
CZ06	SCE	78,813	9,600	1,934	778	744	67	-1
CZ07	SDG&E	76,653	9,425	1,898	739	744	66	18
CZ08	SCE	77,418	9,554	1,948	792	744	66	28
CZ09	SCE	77,625	9,687	1,993	837	744	67	7
CZ10	SDG&E	81,897	9,907	2,032	877	744	69	26
CZ11	PG&E	85,725	10,748	2,259	1,109	1,109	75	-12
CZ12	PG&E	74,131	10,726	2,080	928	928	72	2
CZ13	PG&E	88,060	10,441	2,240	1,089	1,089	73	-2
CZ14	SDG&E	87,498	10,655	2,251	1,097	1,089	74	-31
CZ15	SCE	118,353	9,194	2,444	1,289	1,089	71	-13
CZ16	PG&E	75,373	12,242	2,143	983	983	82	2

Table 27. Mixed Fuel Baseline Model – Small Hotel

Climate zone	Utility	Annual Electricity Consumption (kWh)	Annual Natural Gas Consumption (therms)	Total kTDV/ft2	Total Compliance kTDV/ft2	Efficiency Compliance kTDV/ft2	GHG Emissions	Total Compliance Margin
CZ01	PG&E	230,187	16,824	299	161	173	137	7
CZ02	PG&E	243,164	13,161	287	152	169	117	5
CZ03	PG&E	232,511	12,725	272	136	151	113	6
CZ04	PG&E	251,386	11,608	280	146	165	109	5
CZ05	PG&E	232,585	12,375	264	127	143	111	6
CZ06	SCE	251,627	10,100	260	124	143	100	4
CZ07	SDG&E	250,625	9,977	257	120	143	100	3
CZ08	SCE	271,204	9,874	269	136	143	101	3
CZ09	SCE	265,607	10,246	273	140	143	103	4
CZ10	SDG&E	276,218	9,903	276	142	143	102	3
CZ11	PG&E	285,482	12,457	315	179	197	118	4
CZ12	PG&E	263,561	11,890	293	158	176	112	2
CZ13	PG&E	293,124	11,309	310	175	193	113	1
CZ14	SDG&E	276,292	12,071	298	166	193	115	2
CZ15	SCE	349,319	7,895	309	174	193	98	-4
CZ16	PG&E	228,611	17,363	310	170	195	142	9

Get In Touch

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

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

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

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

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

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

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EXHIBIT A

STANDARD FINDINGS FOR SAN FRANCISCO BUILDING STANDARDS CODE AMENDMENTS:

1. Certain buildings/occupancies in San Francisco are at increased risk for earthquake-induced failure and consequent fire due to local hazardous micro zones, slide areas, and local liquefaction hazards. (Geology)

2. Certain buildings/occupancies in San Francisco are at increased risk of fire due to high density of buildings on very small lots, with many buildings built up to the property lines. (Topography)

3. Topography of San Francisco has let to development of a high density of buildings on small lots, necessitating special provisions for exiting, fire separation, or fire-resistive construction. (Topography)

4. Many buildings are built on steep hills and narrow streets, requiring special safety consideration. (Topography)

5. Additional fire, structural and other protection is required due to high building density and crowded occupancy. (Topography)

6. San Francisco has narrow, crowded sidewalks due to building and population density and unusual topography. (Topography)

7. All rain water in San Francisco drains to the building drains and sewer; unusual geology, occasional extremely high local rainfall amounts, and the configuration of the City as a peninsula restrict the installation of separate storm water and sewer systems. (Topography, Climate, Geology)

8. Moist, corrosive atmosphere of salt-laden fog in San Francisco necessitates additional requirements. (Climate)

9. Not a building standard; no local findings required.

10. Soil conditions in this region induce adverse reactions with some materials, leading to premature failures and subsequent unsanitary conditions. (Climate)

11. The region is subject to fluctuating rainfall due to changes in climatic conditions. (Climate)

12. San Francisco is a peninsula surrounded on three sides by water at sea level; mitigation of climate change impacts, including sea level rise, is critical to the

long term protection of the local built environment and local infrastructure. (Topography)

13. Climate and potential climate change impacts San Francisco's water resources, including reservoirs and distribution facilities. (Climate)

14. Organic material in San Francisco's waste breaks down into methane gas which is a significant contributor to climate change. (Climate)

15. San Francisco is topographically constrained and its built environment occupies most available land, requiring minimization of debris and solid waste. (Topography)

16. Prevailing winds, coastal mountain ranges, and periodic seasonal high temperatures contribute to photochemical reactions that produce smog and ozone; limiting the emission of smog's chemical precursors - volatile organic chemicals and oxides of nitrogen - is necessary to health and safety. (Climate, Topography)

17. The aquifers underlying San Francisco are small relative to local population, necessitating ongoing water imports and special provisions to ensure efficient use of water in local buildings. (Geology)

2022 San Francisco Green Building Code Findings

Section #	Finding #	Section #	Finding #	Section #	Finding #

CHAPTER 1

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101.3.1	9	101.7	9		

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CHAPTER 4

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4.103.2.3	14,15	4.105.1	12,14,15	4.201	9
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4.103.2.4.1	7,11	4.105.1.2	12,14,15	4.201.3	1,2,3,4,5,12
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CHAPTER 5

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5.103.1	9	5.103.1.10	9	5.104.2	9
5.103.1.1	5, 7,11,12,13, 14,15,16,17	5.103.3	9	5.105.1	12,14,15
5.103.1.2	11,13,17	5.103.3.1	5,7,11,12,13, 14,15,16,17	5.105.1.1	12,14,15
5.103.1.3	14,15	5.103.3.2	5,8,14,15,16	5.105.1.2	12,14,15
5.103.1.4	12	5.103.4	9	5.106.5.3	12,14,15,16
5.103.1.6	7,11	5.103.4.1	5,7,11,12,13, 14,15,16,17	5.201.1.1	3,5,12,16
5.103.1.7	9	5.103.4.2	5,8,14,15,16	5.201.1.2	3,5,7,12,13,17
5.103.1.8	5,8,14,15,16	5.104.1	12,14,15		

CHAPTER 6
NO S.F. AMENDMENTS

CHAPTER 7

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702.2	9				

2022
San Francisco Green Building Code

Amendments to the

2022 California Green Building Standards Code (CALGreen)

Operative date: January 1, 2023

PROPOSED SAN FRANCISCO GREEN BUILDING CODE AMENDMENTS

2022 Edition

Text Format:

Explanatory remarks are boxed and italicized.

Unchanged language from the 2022 California Code is shaded, and may include **bold** and/or *italicized* formatting.

San Francisco amendments are printed in unformatted ("plain") text, and may include **bold** and/or *italicized* formatting.

Repealed San Francisco amendments appear ~~plain and strikeout.~~

New San Francisco amendments appear underlined.

Marginal Markings:

[←] An arrow represents the location of language that has been deleted by San Francisco from the 2022 California Code.

Chapter 1

ADMINISTRATION

SECTION 101 – GENERAL

101.1 Revise this section as follows:

101.1 Title. These regulations shall be known as the San Francisco Green Building Code, and may be cited as such, and will be referred to herein as "this code." The San Francisco Green Building Code is Part 11 of thirteen parts of the official compilation and publication of the adoption, amendment and repeal of building regulations to the California Code of Regulations, Title 24,and Chapter 13C of San Francisco Building Inspection Commission Amendments to the California Building Standards Code.

101.2 Revise this section as follows:

101.2 **Purpose.** The purpose of this chapter is to promote the health, safety and general welfare of San Francisco residents, workers, and visitors by minimizing waste of energy, water, and other resources in the construction and operation of buildings in the City and County of San Francisco and by providing a healthy indoor environment. The green building practices required by this chapter will also further the goal of reducing the greenhouse gas emissions in the City and County of San Francisco to ~~25~~ 61 percent below 1990 levels by the year ~~2017~~ 2030, as stated in ~~Board of Supervisors Resolution No. 158-02 and~~ San Francisco Environment Code Chapter 9.

101.3 Revise this section as follows:

101.3 Scope. The provisions of this code shall apply to the planning, design, operation, construction, use and occupancy of every newly constructed building or structure, unless otherwise indicated in this code, as well as alterations to existing buildings throughout the City and County of San Francisco.

While this code references green building programs, the City and County of San Francisco does not confer certification under any green building program.

101.3.1 Revise this section as follows:

101.3.1 Regulated buildings, structures and applications. Provisions of this code shall apply to the

following buildings, structures, and applications regulated by state agencies as specified in Sections 103 through 106 of California Green Building Standards Code Title 24 Part 11, modified by local ordinance with supplemental requirements applicable to occupancy types A, B, I, M, E and R as defined by California Building Code Title 24 Section 302 (~~2019~~ 2022) as amended pursuant to Section 101.7. When adopted by a state agency, the provisions of this code shall be enforced by the appropriate enforcing agency, but only to the extent of authority granted to such agency by statute.

101.4 Revise this section as follows:

101.4 Appendices. [Reserved]

101.6 Revise this section as follows:

101.6.1 Differences. In the event of any differences between these building standards and the standard reference documents, the text of this Chapter shall govern.

101.6.3 Revise this section as follows:

101.6.3 Conflicts. When the requirements of this code conflict with the requirements of any other part of the California Building Standards Code, Title 24, any provision contained elsewhere in the San Francisco Municipal Code, or any regulation or requirement adopted by the Public Utilities Commission or other City agency under its Charter authority, the most restrictive requirement shall prevail.

101.7 Revise this section as follows:

101.7 City and county amendments, additions and deletions. This code includes the amendments, deletions, and additions to California green building requirements which maintain stricter local green building standards.

101.10 Revise this section as follows:

101.10 Equivalency. Wherever reference is made to the LEED® or GreenPoint Rated systems, a comparable equivalent rating system may be used if approved by the Director. The applicable LEED®, GreenPoint Rated or equivalent versions of performance standards for applications subject to this chapter are:

LEED v4 for Interior Design and Construction (LEED v4 ID+C)

LEED v4 for Building Design and Construction (LEED v4 BD+C)

LEED v4 for Homes Design and Construction

GreenPoint Rated (GPR) Single Family New Home Construction – ~~8.0~~ 9.0 or current

GreenPoint Rated (GPR) Multifamily New Home Construction – ~~8.0~~ 9.0 or current

GreenPoint Rated (GPR) Existing Multifamily –v1.0 or current

Wherever specific LEED prerequisites or credits are cited, such references are to LEED v4 BD+C. More recent LEED and GreenPoint Rated versions may be used, provided the credits and points achieved are as or at least as stringent as LEED v4 BD+C or GPR v ~~8.0~~ 9.0.

Wherever the LEED or GreenPoint Rated systems include a minimum energy or other performance requirement, the permit applicant may choose to meet the minimum performance requirements with an alternative equivalent method approved by the Director.

Compliance with any of these requirements may be verified and/or certified by any means, including third-party review or equivalent requirements verified via other rating systems, as approved by the Director.

101.11 Revise this section as follows:

101.11 Effective use of this code. The following steps shall be used to establish which provisions of this code are applicable to a specific occupancy:

1. Establish the type of occupancy.

2. Find the section which covers the established occupancy.

3. Identify the minimum requirements of this code for the established occupancy in Sections 4 and 5.

4. Administrative Bulletin 93, provided by the Department of Building Inspection, summarizes how the requirements of San Francisco Green Building Code and relevant local requirements may be met. Appendices to Administrative Bulletin 93 include tabular summaries of required measures and provide submittal forms.

Chapter 2

DEFINITIONS

SECTION 202 – DEFINITIONS

202 Add and amend the following definitions:

ELECTRIC VEHICLE CHARGING SPACE (EV Space). A space intended for future installation of EV charging equipment and charging of electric vehicles. The EV Space need not be reserved exclusively for

electric vehicle charging.

ELECTRIC VEHICLE CHARGING STATION (EVCS). One or more electric vehicle charging spaces served by electric vehicle charger(s) or other charging equipment allowing charging of electric vehicles. For purposes of determining compliance with accessibility requirements, when the permitted length of time a vehicle may occupy an electric vehicle charging station differs from the permitted duration of stay in publicly accessible parking spaces in the same parking area, electric vehicle charging stations are not considered parking spaces. When the permitted duration of stay in a space served by electric vehicle charger(s) is the same as other publicly accessible parking spaces in the same parking area, EVCS may be considered parking spaces. The EVCS need not be reserved exclusively for electric vehicle charging.

~~***ELECTRIC VEHICLE (EV) FAST CHARGER.*** Off-board charging equipment with a minimum direct current or alternating current power output of 24 kW, for the purpose of providing an electric vehicle charge in significantly less time than a standard Electric Vehicle Charger.~~

~~***ELECTRIC VEHICLE LOAD MANAGEMENT SYSTEM.*** An electronic system designed to allocate charging capacity among EV chargers. An electronic system designed to allocate charging capacity among EV chargers.~~

GREENPOINT RATED, GREENPOINTS and GREENPOINTS CHECKLIST. The residential green building rating system and checklist and certification methodology of the non-profit organization Build It Green.

~~***HIGH-RISE RESIDENTIAL BUILDING.*** For the purposes of this code, a building that is of Occupancy Group R and is four stories or greater.~~

HISTORICAL RESOURCE. A property that meets the terms of the definitions in Section 21084.1 of the CEQA Statute (The California Environmental Quality Act [Public Resources Code Section 21084.1]) and Section 15064.5 of the CEQA Guidelines, as determined by the San Francisco Planning Department.

LARGE COMMERCIAL BUILDING. A commercial building or addition of Group B, M, A, I, or E, occupancy that is 25,000 gross square feet or more.

LEED® and LEED® CHECKLIST. The Leadership in Energy and Environment Design rating system, certification methodology, and checklist of the United States Green Building Council (USGBC).

~~***LOW-RISE RESIDENTIAL BUILDING.*** For the purposes of this code, a building that is of Occupancy Group R and is three stories or less or that is a one or two family dwelling or townhouse.~~

MAJOR ALTERATIONS. Alterations and additions where interior finishes are removed and significant upgrades to structural and mechanical, electrical, and/or plumbing systems are proposed where areas of such construction are 25,000 gross square feet or more in Group B, M, or R occupancies of existing buildings.

MIXED-FUEL BUILDING. A building that uses natural gas or propane as fuel for space heating, water heating (including pools and spas), cooking appliances or clothes drying appliances, or is plumbed for such equipment.

NEW LARGE COMMERCIAL INTERIORS. First- time tenant improvements where areas of such construction are over 25,000 gross square feet or more in Group B or M occupancy areas of existing buildings.

NEWLY CONSTRUCTED (or NEW CONSTRUCTION). A newly constructed building (or new construction) is a building that has never before been used or occupied for any purpose and does not include additions, alterations or repairs.

~~***NONRESIDENTIAL COMPLIANCE MANUAL.*** The document published by the California Energy Commission to aid in compliance and enforcement of the Title 24 California Building Energy Standards, for buildings of nonresidential occupancy and high-rise residential buildings.~~

~~***PASSENGER VEHICLES.*** Motor vehicles designed primarily for transportation of persons, with capacity of 12 persons or less.~~

~~***RESIDENTIAL COMPLIANCE MANUAL.*** The document published by the California Energy Commission to aid in compliance and enforcement of the Title 24 California Building Energy Standards, for low-rise residential buildings.~~

TOTAL ENERGY DESIGN RATING. A metric required by the California Energy Commission to be applied to low-rise residential construction in order to comply with California Title 24 Part 6 Energy Standards. The Total Energy Design Rating has two components: (a) the Energy Efficiency Design Rating; and (b) the Solar Electric Generation and Demand Flexibility Design Rating. The Solar Electric Generation and Demand Flexibility Design Rating is subtracted from the Energy Efficiency Design Rating to determine the Total Energy Design Rating. California Energy Standards require that each building must separately comply with the Energy Efficiency Design Rating and the Total Energy Design Rating.

~~***TRUCKS.*** Trucks or truck-based vehicles with both a payload capacity of 4,000 pounds or less, and a gross vehicle weight ratio of 14,000 pounds or less. As used herein, "trucks" does not include heavy duty vehicles,~~

~~which are vehicles of any type with a gross vehicle weight ratio of more than 14,000 pounds.~~

Chapter 3

GREEN BUILDING

SECTION 301 – GENERAL

301.1 Revise this section as follows:

301.1 Scope. Buildings in the City and County of San Francisco shall be designed to include the green building measures specified as mandatory under the California Green Building Standards Code (CalGreen).

Additional green building requirements established by the City and County of San Francisco are mandatory for:

(1) Newly constructed Group R occupancy buildings,

(2) Newly constructed buildings of Group B, M, A, and I occupancies that are 25,000 gross square feet or more,

(3) New first-time build-outs of commercial interiors that are 25,000 gross square feet or more in buildings of Group B or M occupancies, and

(4) Major alterations that are 25,000 gross square feet or more in existing buildings of Group B, M or R occupancies, where interior finishes are removed and significant upgrades to structural and mechanical, electrical and/or plumbing systems are proposed.

SECTION 302 – MIXED OCCUPANCY BUILDINGS

302.1 Revise this section as follows:

302.1 Mixed Occupancy Buildings. In mixed occupancy buildings, each portion of a building shall comply with the specific measures applicable to each specific occupancy as required by California Code of Regulations Title 24 Part 11 and the San Francisco Green Building Code. However, to fulfill any requirements of San Francisco Green Building Code Sections 4.103 through 4.105 and 5.103 through 5.105, as applicable, the project sponsor may apply a single required green building standard to the entire building.

Exceptions:

1. [HCD] Accessory structures and accessory occupancies serving residential buildings shall comply with Chapter 4 and Appendix A4, as applicable.
2. [HCD] For the purposes of CALGreen, live/work units, complying with Section 419 of the California Building Code, shall not be considered mixed occupancies. Live/work units shall comply with Chapter 4 and Appendix A4, as applicable.

SECTION 303 – PHASED PROJECTS

303.1.1.1 Add the following section:

303.1.1.1 Maintenance of required features. Any structure subject to this chapter shall maintain the green building features required herein, or equivalent, regardless of subsequent alterations, additions, or changes of use, unless subject to subsequent or more stringent requirements.

304 Modify the following section:

SECTION 304 – VOLUNTARY TIERS

This section not applicable in San Francisco.

305 Modify the following section:

SECTION 305 [OSHPD 1] – CALGREEN TIER 1 AND CALGREEN TIER 2

This section not applicable in San Francisco.

306 Modify the following section:

SECTION 306 – VOLUNTARY MEASURES

This section not applicable in San Francisco.

Chapter 4

RESIDENTIAL MANDATORY MEASURES

Division 4.1

PLANNING AND DESIGN

SECTION 4.101 – GENERAL

4101.1 Revise the section as follows:

4.101.1 Scope. The provisions of this division outline planning, design and development methods that include environmentally responsible site selection, building design, building siting and development to protect, restore enhance the environmental quality of the site, respect the integrity of adjacent properties and promote the health, safety and welfare of San Francisco residents.

4.103 Replace this section as follows:

SECTION 4.103 – REQUIREMENTS FOR GROUP R OCCUPANCY BUILDINGS

4.103.1 New low-rise residential buildings.

4.103.1.1 Rating requirements

New residential buildings must be GreenPoint Rated and applicants must submit documentation demonstrating that a minimum of 75 GreenPoints from the GreenPoints Single Family New Construction Checklist or the Green-Points Multifamily New Construction Checklist will be achieved. Alternatively, this rating requirement may be met by obtaining LEED Silver certification.

4.103.1.2 Stormwater management

Projects subject to this section shall meet the San Francisco Public Utilities Commission stormwater management requirements.

4.103.2 New high-rise residential buildings

4.103.2.1 Rating requirement

Permit applicants must submit documentation to achieve LEED® “Silver” certification. Alternatively, this rating requirement may be met by obtaining the Green-Point Rated designation and submitting documentation demonstrating that a minimum of 75 GreenPoints from the GreenPoint Rated Multifamily New Construction checklist will be achieved.

4.103.2.2 [Reserved]

4.103.2.3 Construction debris management. Permit applicants must submit documentation verifying the diversion of a minimum 75 percent of the projects construction and demolition debris. The waste management plan necessary to meet this requirement shall be updated as necessary and shall be accessible during construction for examination by the Department of Building Inspection. Permit applicants must also meet the requirements of San Francisco Environment Code Chapter 14 and San Francisco Building Code Chapter 13B (Construction and Demolition Debris Recovery Program.)

4.103.2.4 Stormwater management. Projects subject to this section shall meet the San Francisco Public Utilities Commission stormwater management requirements.

4.103.2.4.1 Construction activity stormwater pollution prevention. All projects, whether greater or lesser than one acre, must develop and implement construction activity pollution prevention and site run-off controls adopted by the San Francisco Public Utilities Commission.

4.103.3 Major Alterations to Existing Group R Occupancy Buildings.

4.103.3.1 Rating Requirement.

Permit applicants must submit documentation to achieve a LEED® ~~Gold~~ Silver rating. Alternatively, this rating requirement may be met by obtaining the GreenPoint Rated designation and submitting documentation demonstrating that a minimum of 75 GreenPoints from the GreenPoint Rated Multifamily checklist will be achieved. Major alterations applying to less than 80% of the building's gross floor area may alternately submit documentation demonstrating that 49 points from the Green-Point Rated Existing Multifamily checklist have been achieved within the project area.

4.103.3.2 Low-Emitting Materials.

Alterations utilizing LEED must submit documentation verifying that low-emitting materials are used, subject to on-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials wherever applicable: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

Alterations utilizing GreenPoint Rated must submit documentation to verify the use of low-emitting materials meeting the GreenPoint Rated Multifamily New Homes measures for low-emitting coatings, adhesives and sealants, and carpet systems.

~~**4.103.3.3 Electric Vehicle Charging.**~~

~~Sections 4.106.4 through 4.106.4.2.6 of this Chapter shall apply to all newly-constructed buildings and associated newly-constructed parking facilities for passenger vehicles and trucks, and to major alterations to existing Group R occupancy buildings where electrical service to the building will be upgraded. In major alterations where existing electrical service will not be upgraded, the requirements of Sections 4.106.4 through 4.106.4.2.6 shall apply to the maximum extent that does not require an upgrade to existing electrical service.~~

4.104 Replace this section as follows:

SECTION 4.104 – HISTORIC PRESERVATION

4.104.1 On-site retention of historical features. For alterations of buildings determined to be historical resources, after demonstrating compliance with all applicable codes, including the ~~2019~~ 2022 California Building Energy Efficiency Standards (Title 24, Part 6) and the ~~2019~~ 2022 California Historical Building Code (Title 24, Part 8), the minimum points or credits required under this chapter shall be reduced for retention and in-situ reuse or restoration of certain character defining features, as described in Table 4.104A. Retention includes the rehabilitation and repair of character-defining features that conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.

TABLE 4.104.A

SIGNIFICANT HISTORICAL ARCHITECTURAL FEATURES	PERCENT RETAINED*	ADJUSTMENT TO MINIMUM LEED POINT REQUIREMENT	ADJUSTMENT TO MINIMUM GREEN-POINTS REQUIREMENT
Windows @ principal façade(s)	100%	4	15
Other windows	At least 50%	1	3
Other windows	100%	2	6
Exterior doors @ principal façade(s)	100%	1	3
Siding or wall finish @ principal façade(s)	100%	1	4
Trim & casing @ wall openings on principal façade(s)	100%	1	3

Roof cornices or decorative eaves visible from right-of-way	100%	1	3
Sub-cornices, belt courses, water tables, and running trim visible from right-of-way	100%	1	3
Character-defining elements of significant interior spaces	100%	4	15
Other exterior ornamentation (e.g. cartouches, corbels, quoins, etc.) visible from right-of-way	80%	1	3

4.104.2. Adjustment to Green Credit for Retention of Historic Features. Where the historical resource is a portion of the total project, the LEED or GreenPoint Rated requirement shall be adjusted to equal the percentage of gross floor area of the historical resource compared to the total project gross floor area.

4.105 Replace this section as follows:

SECTION 4.105 – DEMOLITION OF EXISTING STRUCTURES

4.105.1 Adjustments to Rating Requirements for Building Demolition and Density. Applications subject to the San Francisco Green Building Code, whereby construction of a new building is proposed within five years of the demolition of a building on the site, where such demolition occurred after the effective date of the Green Building Ordinance - November 3, 2008 - the sustainability requirements for new buildings pursuant to the San Francisco Green Building Code shall be increased as follows:

4.105.1.1 LEED® Projects. For projects attaining a LEED® certification:

(1) Where the building demolished was an historical resource, the required points shall be increased by 10 points.

(2) Where the building demolished was not an historical resource, the required points shall be increased by 6 additional points.

(3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 5 additional points.

4.105.1.2 GreenPoint Rated Projects. For projects attaining GreenPoint Rated:

(1) Where the building demolished was an historical resource, the required points shall be increased by 25 additional points.

(2) Where the building demolished was not an historical resource, the required points shall be increased by 20 additional points.

(3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 17 additional points.

SECTION 4.106 – SITE DEVELOPMENT

4.106 .4 Revise this section as follows:

4.106.4 Electric vehicle (EV) charging for new construction ~~and major alterations~~. New construction shall comply with Section 4.106.4.1 or 4.106.4.2 to facilitate future installation and use of EV chargers. Electric vehicle supply equipment (EVSE) shall be installed in accordance with the *California Electrical Code*, Article 625.

Exceptions:

1. On a case-by-case basis, where the local enforcing agency has determined EV charging and infrastructure are not feasible based upon one or more of the following conditions:

   1.1. Where there is no local utility power supply or the local utility is unable to supply adequate power.

   1.2. Where there is evidence suitable to the local enforcing agency substantiating that additional local utility infrastructure design requirements, directly related to the implementation of Section 4.106.4, increase the utility side cost to the homeowner or the developer by more than $400 per parking space. In such cases, buildings subject to Section 4.106.4 shall maximize the number of EV Charging Spaces, up to a utility side cost of a maximum of $400 per space. Cost shall be determined by dividing the increase in local utility infrastructure cost attributable to compliance with this section by the sum of parking spaces and EV Charging Spaces.

2. Accessory Dwelling Units (ADU) and Junior Accessory Dwelling Units (JADU) without additional parking facilities.

~~3. In major alterations, where there is evidence substantiating that meeting the requirements of this section presents an unreasonable hardship or is technically infeasible, the Director may consider an appeal from the project sponsor to reduce the number of EV Charging Spaces required or provide for EV charging elsewhere.~~

~~4. Where a project is undertaken specifically to meet the City's Mandatory Seismic Retrofit Program as required under Chapter 4A, 4B, or 4D of the San Francisco Existing Building Code.~~

4.106.4.1 New one-and-two-family dwellings and townhouses with attached or adjacent private garages. For each parking space, install a 40-Amp 208 or 240-volt branch circuit, including raceway, electrical panel capacity, overprotection devices, wire, and termination point such as a receptacle. The termination point shall be in close proximity to the proposed EV charger location. Raceways are required to be continuous at enclosed, inaccessible, or concealed areas and spaces. Raceway for each circuit shall not be less than trade size 1 (nominal 1-inch inside diameter).

4.106.4.1.1 Identification. The service panel or subpanel circuit directory shall identify the overcurrent protective device space(s) reserved for future EV charging as "EV READY" for full circuits ~~and otherwise "EV CAPABLE"~~. The raceway termination location shall be permanently and visibly marked as "EV READY" for full circuits. ~~and otherwise "EV CAPABLE".~~

~~*4.106.4 Modify this section as follows and delete notes 1 and 2:*~~

4.106.4.2 ~~New multifamily dwelling and major alterations.~~ ~~If residential parking is available, one hundred (100) percent of the total number of parking spaces on a building site, provided for all types of parking facilities, shall be electric vehicle charging spaces (EV spaces) capable of supporting future EVSE. Calculations for the required number of EV spaces shall be rounded up to the nearest whole number.~~

~~[Notes 1 and 2 deleted.]~~

4.106.4.2.2.1.2 Electric vehicle charging stations (EVCS) dimensions. ~~Unless otherwise specified by the Planning Code Section 154,~~ The charging spaces shall be designed to comply with the following:

1. The minimum length of each EV space shall be 18 feet (5486 mm).
2. The minimum width of each EV space shall be 9 feet (2743 mm).

3. One in every 25 charging spaces, but not less than one, shall also have an 8- foot (2438 mm) wide minimum aisle. A 5-foot (1524 mm) wide minimum aisle shall be permitted provided the minimum width of the EV space is 12 feet (3658 mm).

    a. Surface slope for this EV space and the aisle shall not exceed 1 unit vertical in 48 units horizontal (2.083 percent slope) in any direction.

    b. Notwithstanding any other applicable requirements, when an EV charger is installed serving an accessible parking space, the space may be considered a parking space if the duration of stay is not subject to any limitations different from those generally applied to other publicly accessible parking spaces in the same parking area. If the duration of stay in an accessible space equipped with an EV charger is subject to limitations different from those generally applied to other publicly accessible parking spaces in the same parking area, the space is not a parking space.

~~4. Accessible space must meet the dimensions specified above, Planning Code Section 154, or other applicable accessibility requirements whichever would result in the largest space size.~~

4.106.4.2.2.1.3 Accessible EV spaces. In addition to the requirements in Sections 4.106.4.2.2.1.1 and 4.106.4.2.2.1.2, all EVSE, when installed, shall comply with the accessibility provisions for EV chargers in the *California Building Code*, Chapter 11B. EV ready spaces and EVCS in multifamily developments shall comply with *California Building Code*, Chapter 11A, Section 1109A. Accessible spaces must meet the dimensions specified ~~above~~ in Section 4.106.4.2.2.1.2, Planning Code Section 154, or other applicable accessibility requirements, whichever would result in the largest space size.

~~**4.106.4.2.3 Single EV space required.** [←] Where a single EV space is required, install a full circuit with a minimum of 40-Amp 208 or 240 Volt capacity, including listed raceway, sufficient electrical panel capacity, overcurrent protection devices, wire, and termination point such as a receptacle. The termination point shall be in close proximity to the proposed EV charger location. The raceway shall not be less than trade size 1 (nominal 1 inch inside diameter).~~

~~**4.106.4.2.4 Multiple EV spaces required.** [←]~~

~~(a) For a minimum of 10% of EV Spaces and in no case less than two EV Spaces when the total number of EV Spaces is two or more, install a full circuit with minimum of 40-Amp 208 or 240 Volt capacity per EV Space, including listed raceway, sufficient electrical panel service capacity, overcurrent protection devices,~~

wire, and suitable listed termination point such as a receptacle. The termination point shall be in close proximity to the proposed EV charger location. Calculations for the number of EV Spaces shall be rounded up to the nearest whole number.

(b) Branch circuit panelboard(s) shall be installed at each parking level with service capacity to deliver a minimum 40 amperes at 208 or 240 volts multiplied by 20% of the total number of EV Spaces. The panelboard(s) shall have sufficient space to install a minimum of one 40-ampere dedicated branch circuit and overcurrent protective device per EV Space up to a minimum of 20% of the total number of EV Spaces. The circuits and overcurrent protective devices shall remain reserved exclusively for EV charging.

Exception: Circuits and overcurrent protective devices in panelboards not located on the same level may contribute to the requirements of 4.106.4.2.4(b), provided the circuits are reserved exclusively for EV charging. For example, the circuit serving an EV Space dedicated to a condominium owner may connect to the electrical panelboard of the corresponding condominium.

(c) For all EV Spaces not required to install full circuits or raceway per Section 4.106.4.2.4(a):

(1) Either:

(A) Provide sufficient space for future installation of additional electrical panelboard(s) to support a 40-ampere 208 or 240 Volt capacity branch circuit and overcurrent protection device per EV Space, or equivalent consistent with Section 4.106.4.2.4.1; or

(B) Provide space in installed electrical panelboard(s) to support installation of a 40 ampere 208 or 240 Volt capacity branch circuit and overcurrent protection device per EV Space, or equivalent consistent with Section 4.106.4.2.4.1.

(2) Install raceway or sleeves where penetrations to walls, floors, or other partitions will be necessary to install panels, raceways, or related electrical components necessary per site conditions for future installation of branch circuits. All such penetrations must comply with applicable codes, including but not limited to the San Francisco Electrical Code and the San Francisco Fire Code.

(d) Construction documents, including electrical engineering and design related documents, shall demonstrate that the electrical service capacity and electrical system, including any on-site distribution transformer(s), can charge EVSE at a minimum of 20% of the total number of EV Spaces simultaneously, at the full rated amperage of the EVSE or a minimum of 40 amperes per branch circuit, as modified by Section 4.106.4.2.4.1 Electric Vehicle Fast Charging Spaces. As appropriate, construction documents shall

~~provide information on raceway method(s), wiring schematics, anticipated EV load management system design(s), and electrical load calculations.~~

~~**NOTES:**~~

~~1. Electric vehicle charging infrastructure and housing are critical priorities for the City and County of San Francisco. Where provisions of this Section 4.106.4.2.4 require the installation of an electrical transformer, and such transformer cannot be accommodated on the project site due to the combination of project site dimensions, San Francisco Building Code, San Francisco Electrical Code, and applicable utility regulations, the Director of Public Works is encouraged to issue a Sidewalk Vault Encroachment Permit, provided that the fronting property owner complies with all requirements governing street occupancy, including but not limited to the San Francisco Public Works Code and Department of Public Works Order 165,553.~~

~~2. An EV load management system may be necessary in order to provide EV charging at more than 20% of EV Spaces.~~

~~3. This section does not require EV chargers to be installed.~~

4.106.4.2.3 EV space requirements.

1. **Single EV space required.** Where a single EV space is required, install a full circuit with a minimum of 40-Amp 208 or 240 Volt capacity, including listed raceway, sufficient electrical panel capacity, overcurrent protection devices, wire, and termination point such as a receptacle. The termination point shall be in close proximity to the proposed EV charger location. The raceway shall not be less than trade size 1 (nominal 1-inch inside diameter).
2. **Multiple EV spaces required.** Construction documents shall indicate the raceway termination point and the location of installed or future EV spaces, receptacles, or EV chargers. Construction documents shall also provide information on amperage of installed or future receptacles or EVSE, raceway method(s), wiring schematics and electrical load calculations. Plan design shall be based upon a 40-ampere minimum branch circuit. Required raceways and related components that are planned to be installed underground, enclosed, inaccessible or in concealed areas and spaces shall be installed at the time of original construction.

   Exception: A raceway is not required if a minimum 40-ampere 208/240-volt dedicated EV branch circuit is installed in close proximity to the location or the proposed location of the EV space at the

time of original construction in accordance with the *California Electrical Code*.

a. **Multiple Levels of Parking:**

i. Branch circuit panelboard(s) shall be installed at each parking level with service capacity dedicated to EV Capable Spaces and EV spaces proportional to the number of vehicle spaces on each level, including panelboard(s) space and capacity. The circuits and overcurrent protective devices shall remain reserved exclusively for EV charging.

Exception: Circuits and overcurrent protective devices in panelboards not located on the same level may contribute to the requirements of 4.106.4.2.4(b), provided the circuits are reserved exclusively for EV charging. For example, the circuit serving an EV Space dedicated to a condominium owner may connect to the electrical panelboard of the corresponding condominium.

ii. Install raceway or sleeves where penetrations to walls, floors, or other partitions will be necessary to install panels, raceways, or related electrical components necessary per site conditions for future installation of branch circuits. All such penetrations must comply with applicable codes, including but not limited to the San Francisco Electrical Code and the San Francisco Fire Code.

NOTES:

Electric vehicle charging infrastructure and housing are critical priorities for the City and County of San Francisco. Automated Load Management Systems, energy efficiency, and selection of low-amperage technologies can help mitigate increases to peak electric load. Where the installation of a utility electrical transformer may be determined to be necessary in the context of compliance with Section 4.106.4.2.4 of this chapter, SF Building Code Section 106A.1.17.1, or other provisions of the San Francisco Electrical Code, and where such transformer cannot be accommodated on the project site due to the combination of project site dimensions, San Francisco Building Code, San Francisco Electrical Code, and applicable utility regulations, the Director of Public Works is encouraged to issue a Sidewalk Vault Encroachment Permit, provided that the fronting property owner complies with all requirements governing street occupancy, including but not limited to the San Francisco Public

Works Code and Department of Public Works Order 165,553.

~~**4.106.4.2.4.1 Electric Vehicle (EV) fast charging spaces.**~~

~~(a) Installation of one EV Fast Charger may reduce the number of EV Spaces required under Section 4.106.4.2.4(a) by up to five EV Spaces, provided that the project includes at least one EV Space equipped with a full circuit able to deliver 40-Amp 208 or 240 Volt capacity to the EV Space, including listed raceway, sufficient electrical panel capacity, overcurrent protection devices, wire, and suitable listed termination point such as a receptacle.~~

~~The electrical panel board(s) provided at each parking level served by EV Fast Chargers shall have sufficient capacity to supply each EV Fast Charger with a minimum of 30 kW AC in addition to the capacity to serve any remaining EV Spaces required under Section 4.106.4.2.4(a) with a minimum of 40 amperes per circuit at 208 or 240 volts per EV Space.~~

~~(b) After the requirements of 4.106.4.2.4(a) are met, each planned EV Fast Charger may reduce the number of planned EV Spaces required under 4.106.4.2.4(c) by up to five spaces. Electrical engineering design and construction documents shall indicate the raceway termination point and proposed location of future EV fast charger spaces and EV fast chargers. Electrical engineering design and construction documents shall also provide information on amperage of EV fast chargers, raceway method(s), wiring schematics, and electrical load calculations to verify that the electrical panel service capacity and electrical system has sufficient capacity to simultaneously operate all installed EV fast chargers at the full rated amperage of the EV fast charger(s) and simultaneously serve any remaining spaces required by 4.106.4.2.4(a). Raceways and related components that are planned to be installed underground, enclosed, inaccessible, or in concealed areas and spaces shall be installed at the time of original construction.~~

4.106.4.2.4 Identification. The service panel or subpanel circuit directory shall identify the overcurrent protective device space(s) reserved for future EV charging purposes as "EVSE READY" for full circuits and otherwise "EVSE CAPABLE" in accordance with the California Electrical Code. ~~The raceway termination location or receptacle shall be permanently and visibly marked as "EVSE READY" for full circuits and otherwise "EVSE CAPABLE," until such time as EVSE are installed.~~

Division 4.2

ENERGY EFFICIENCY

SECTION 4.201– GENERAL

4.201 Add the following section:

4.201.2. ~~Renewable energy and~~ Better roofs.

(a) Newly constructed Group R occupancy buildings ~~which are 4 occupied floors or greater, and less than or equal to 10 or fewer occupied floors and which apply for a building permit on or after January 1, 2017 shall install photovoltaic systems and/or solar thermal systems in the solar zone required by California Code of Regulations (CCR), Title 24, Part 6 Section 110.10.~~ are required by California Title 24 Part 6 Energy Standards to install photovoltaic (PV) energy systems. For newly constructed multifamily buildings the minimum size of such systems is required by Section 170.2(f) and 170.2(g) to be not less than the smaller of PV system size determined by Equation 170.2-C or Equation 170.2-D, or the total of all Solar Access Roof Area (SARA) multiplied by 14 W/ft^2. Projects that constitute a Large Development Project or Small Development Project under the Stormwater Management Ordinance (Public Works Code secs 147-147.6) may exclude from SARA any roof area where both:

(1) The area is occupied by living roof, meaning the area of media for growing plants, and

(2) The area occupied by living roof contributes to determination of compliance with the Stormwater Management Ordinance, as documented by a Preliminary Stormwater Control Plan or a Modified Compliance Application submitted to the San Francisco Public Utilities Commission.

(b) In any final Stormwater Control Plan approved by the San Francisco Public Utilities Commission, including where such approval may occur subsequent to addenda to a Site Permit wherein compliance with California Title 24 Part 6 Energy Standards is documented, the applicant shall ensure the area occupied by living roof contributing to determination of compliance with the Stormwater Management Ordinance is no less than the square footage approved for exclusion from SARA.

~~(b) The minimum solar zone area for the project shall be calculated under Title 24, Part 6, Section 110.10(b) through (e), as applicable, and Residential Compliance Manual Chapter 7 or Nonresidential Compliance Manual Chapter 9, as applicable, except as provided below.~~

~~(1) For High Rise Multifamily Buildings and Hotel/Motel Occupancies, Exceptions 3 and 5 to Title 24,~~

Part 6, Section 110.10(b)1B may be applied in the calculation of the minimum solar zone area. Exceptions 1, 2, and 4 may not be applied in the calculation. For High Rise Multifamily Buildings and Hotel/Motel Occupancies subject to Planning Code Section 149, Exception 5 may be applied in the calculation of the minimum solar zone area, and Exceptions 1, 2, 3, and 4 may not be applied in the calculation.

(2) Buildings with a calculated minimum solar zone area of less than 150 contiguous square feet due to limited solar access under Exception 5 to Title 24, Part 6, Section 110.10(b)1A or Exception 3 to Title 24, Part 6, Section 110.10(b)1B are exempt from the solar energy requirements in this Section 4.201.2.

(c) The sum of the areas occupied by solar photovoltaic collectors and/or solar thermal collectors must be equal to or greater than the solar zone area. The solar zone shall be located on the roof or overhang of the building, or on the roof or overhang of another structure located within 250 feet of the building or on covered parking installed with the building project. Solar photovoltaic systems and solar thermal systems shall be installed in accord with: all applicable State code requirements, including access, pathway, smoke ventilation, and spacing requirements specified in CCR Title 24, Part 9; all applicable local code requirements; manufacturer's specifications; and the following performance requirements:

(1) Solar photovoltaic systems: The total nameplate capacity of photovoltaic collectors shall be at least 10 $Watts_{DC}$ per square foot of roof area allocated to the photovoltaic collectors.

(2) Solar thermal systems: Single family residential solar domestic water heating systems shall be OG- 300 System Certified by either the Solar Rating and Certification Corporation (SRCC) or the International Association of Plumbing and Mechanical Officials (IAPMO). Solar thermal systems installed in all Group R occupancy buildings other than single family residences shall use collectors with OG-100 Collector Certification by SRCC or IAPMO, shall be designed to generate annually at least 100 kBtu per square foot of roof area allocated to the solar thermal collectors. Systems with at least 500 square feet of collector area shall include a Btu meter installed on either the collector loop or potable water side of the solar thermal system. Approval by the Planning Department of compliance with the Better Roof requirements, including the Living Roof alternative, as provided in Planning Code Section 149, shall be accepted for compliance with San Francisco Green Building Code Section 4.201.2(a) through (c). The requirements of CCR Title 24, Part 6, Section 110.10 for

~~the solar zone shall still apply.~~

~~(d) Approval by the Planning Department of compliance with the Better Roof requirements, including the Living Roof alternative, as provided in Planning Code Section 149, shall be accepted for compliance with San Francisco Green Building Code Section 4.201.2(a) through (c). The requirements of CCR Title 24, Part 6, Section 110.10 for the solar zone shall still apply.~~

4.201.3 Energy Performance.

(a) All-electric buildings. A newly constructed residential all-electric building shall be designed and constructed such that the Energy Budget ~~Total Energy Design Rating and Energy Efficiency Design Rating~~ for the proposed building ~~are~~ is no greater than the corresponding Energy Budget for a Standard Design Building compliant with California Title 24 Part 6 Energy Standards.

~~**(b) Mixed-fuel low-rise residential buildings.** A newly constructed mixed-fuel low-rise residential building shall:~~

~~(1) Be designed and constructed such that the Total Energy Design Rating and Energy Efficiency Design Rating for the proposed building is no greater than the Total Energy Design Rating and Energy Efficiency Design Rating for the Standard Design Building; and~~

~~(2) Be designed and constructed such that the Total Energy Design Rating for the proposed building is 14 or less, as calculated by compliance software approved by the California Energy Commission.~~

~~**Exception:** Mixed-fuel low-rise residential buildings with limited solar access are excepted if a photovoltaic (PV) system meeting the minimum requirements as specified in California Energy Standards Joint Appendix JA11 is installed on all available areas of 80 contiguous square feet or more with effective annual solar access. Effective annual solar access shall be 70% or greater of the output of an unshaded PV array on an annual basis, wherein shade is due to existing permanent natural or human-made barriers external to the dwelling, including but not limited to trees, hills, and adjacent structure~~

(b) **Mixed-fuel ~~high-rise~~ residential buildings.** A newly constructed mixed-fuel ~~high-rise~~ residential building shall be designed and constructed such that the Energy Budget is no greater than 90% of the Title 24 Part 6 Energy Budget for the Standard Design Building as calculated by compliance software approved by the California Energy Commission.

Chapter 5

NONRESIDENTIAL MANDATORY MEASURES

Division 5.1

PLANNING AND DESIGN

SECTION 5.101 – GENERAL

5.101.1 Modify the section as follows:

5.101.1 Scope. The provisions of this chapter outline planning, design and development methods that include environmentally responsible site selection, building design, building siting and development to protect, restore and enhance the environmental quality of the site, respect the integrity of adjacent properties, and promote the health, safety and welfare of San Francisco residents.

5.103 Replace this section as follows:

SECTION 5.103 – REQUIREMENTS FOR GROUP A, B, I, E and M BUILDINGS

~~***5.103.1 New large commercial buildings.***~~

5.103.1 New large commercial buildings.

5.103.1.1 Rating requirement. Permit applicants must submit documentation to achieve LEED "Gold" certification.

5.103.1.2 Indoor water use reduction. Permit applicants must submit documentation verifying that project meets maximum prescriptive fixture flow rates in accordance with the California Plumbing Code. The project must also achieve the LEED WE Prerequisite Indoor Water Use Reduction (WEp2) and a minimum 30 percent reduction in the use of indoor potable water, as calculated to meet the LEED WE credit Indoor Water Use Reduction (WEc2).

5.103.1.3 Construction waste management. Permit applicants must submit documentation verifying the diversion of a minimum 75 percent of the project's construction and demolition waste, as calculated to meet

LEED MR Prerequisite Construction and Demolition Waste Management Planning and LEED MR Credit Construction and Demolition Waste Management. Permit applicants must also meet the requirements of San Francisco Environment Code Chapter 14 and San Francisco Building Code Chapter 13B (Construction and Demolition Debris Recovery Program.) The waste management plan necessary to meet this requirement shall be updated as necessary and shall be accessible during construction for examination by the Department of Building Inspection.

5.103.1.4 Commissioning. Permit applicants must submit documentation verifying that the facility has been or will meet the criteria necessary to achieve CALGreen section 5.410.2 and Option 1 of LEED EA credit (Enhanced Commissioning), in addition to LEED EA Prerequisite (Fundamental Commissioning) and Verification.

5.103.1.6 Stormwater management. Projects subject to this section shall meet the San Francisco Public Utilities Commission stormwater management requirements. All new building projects must develop and implement an Erosion and Sediment Control Plan or Stormwater Pollution Prevention Plan and implement site run-off controls adopted by the San Francisco Public Utilities Commission as applicable.

5.103.1.7 Energy performance. [Reserved]

5.103.1.8 Temporary ventilation and IAQ management during construction. Permit applicants must submit documentation verifying that an Indoor Air Quality Management Plan is prepared and implemented which meets LEED EQ Credit Construction Indoor Air Quality Management and Title 24 Part 11 Sections 5.504.1 and 5.504.3.

5.103.1.9 Low-Emitting Materials. Permit applicants must submit documentation verifying that low-emitting materials are used, subject to on-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials wherever applicable: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

5.103.1.10 CALGreen mandatory measures. The following measures are mandatory in California for new non-residential buildings. Optionally, similar LEED credits can be used as alternative compliance paths, as noted below:

Title 24 Part 11 Section(s)	**Topic/Requirement**	**Alternate Compliance Option:**

5.106.8	Light pollution reduction	Meet LEED SS Credit Light Pollution Reduction
5.508.1.2	Halons not allowed in HVAC, refrigeration and fire suppression equipment.	Meet LEED EA Credit Enhanced Refrigerant Management, and additionally document that all HVAC&R systems do not contain CFCs or halons.

5.103.3 Major alterations to existing non-residential buildings.

5.103.3.1 Rating requirement. Permit applicants must submit documentation to achieve LEED "Gold" certification.

5.103.3.2 Low emitting materials. Permit applicants must submit documentation verifying that low-emitting materials are used, subject to in-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

5.103.3.3 Electric vehicle charging. Section 5.106.5.3 of this chapter shall apply to ~~all newly constructed buildings and associated newly-constructed parking facilities for passenger vehicles and trucks, and to~~ major alterations and newly-constructed parking facilities associated with existing Group A, B, I, and M occupancy buildings where electrical service to the building will be upgraded. In major alterations where existing electrical service will not be upgraded, all requirements under Section 5.106.5 shall apply to the maximum extent that:

(1) does not require upgrade to existing service; and

(2) the Director does not determine that compliance with Section 5.106.5.3.3 and Title 24 Chapter 11B, if applicable, is technically infeasible, as defined in California Building Code Chapter 2, Section 202.

5.103.4 New large commercial interiors.

5.103.4.1 Rating requirement. Permit applicants must submit documentation to achieve LEED "Gold" certification.

5.103.4.2 Low emitting materials. Permit applicants must submit documentation verifying that low-emitting materials are used, subject to in-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

5.104 Replace this section as follows:

SECTION 5.104 – HISTORIC PRESERVATION

5.104.1 On-site Retention of Historical Features. For alterations of buildings determined to be historical resources, after demonstrating compliance with all applicable codes, including the ~~2019~~ 2022 California Building Energy Efficiency Standards (Title 24, Part 6) and the ~~2019~~ 2022 California Historical Building Code (Title 24, Part 8), the minimum points or credits required under this chapter shall be reduced for retention and in-situ reuse or restoration of certain character defining features, as described in Table 5.104A. Retention includes the rehabilitation and repair of character-defining features that conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.

TABLE 5.104.A

SIGNIFICANT HISTORICAL ARCHITECTURAL FEATURES	PERCENT RETAINED*	ADJUSTMENT TO MINIMUM LEED POINT REQUIREMENT	ADJUSTMENT TO MINIMUM GREEN-POINTS REQUIREMENT
Windows @ principal façade(s)	100%	4	15
Other windows	At least 50%	1	3
Other windows	100%	2	6
Exterior doors @ principal façade(s)	100%	1	3
Siding or wall finish @ principal façade(s)	100%	1	4
Trim & casing @ wall openings on principal façade(s)	100%	1	3
Roof cornices or decorative eaves visible from right-of-way	100%	1	3
Sub-cornices, belt courses, water tables, and running trim visible from right-of-way	100%	1	3

Character-defining elements of significant interior spaces	100%	4	15
Other exterior ornamentation (e.g. cartouches, corbels, quoins, etc.) visible from right-of-way	80%	1	3

5.104.2. Adjustment to Green Credit for Retention of Historic Features. Where the historical resource is a portion of the total project, the LEED or GreenPoint Rated point requirement shall be adjusted to equal the percentage of gross floor area of the historical resource compared to the total project gross floor area.

5.105 Replace this section as follows:

SECTION 5.105 – DEMOLITION OF EXISTING STRUCTURES

5.105.1 Adjustments to rating requirements. Applications subject to the San Francisco Green Building Code, whereby construction of a new building is proposed within five years of the demolition of a building on the site, where such demolition occurred after November 3, 2008, the sustainability requirements for new buildings pursuant to the San Francisco Green Building Code shall be increased as follows:

5.105.1.1 LEED® projects. For projects attaining a LEED® certification:

(1) Where the building demolished was an historical resource, the required points shall be increased by 10 points, which is 10% of the total available in the LEED® rating system, absent demolition.

(2) Where the building demolished was not an historical resource, the required points shall be increased by 6 additional points, which is 10% of the maximum total required points under this chapter, absent demolition.

(3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 5 additional points, which is 8% of the maximum total required points under this chapter, absent demolition.

5.105.1.2 GreenPoint rated projects. For projects attaining GreenPoint Rated:

(1) Where the building demolished was an historical resource, the required points shall be increased by 25

additional points.

(2) Where the building demolished was not an historical resource, the required points shall be increased by 20 additional points.

(3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 17 additional points.

SECTION 5.106 – SITE DEVELOPMENT

5.106.5.3 Revise this section as follows:

5.106.5.3 Electric vehicle (EV) charging. [N] Construction to provide electric vehicle infrastructure and facilitate electric vehicle charging shall comply with Section 5.106.5.3 and shall be provided in accordance with regulations in the *California Building Code* and the *California Electrical Code*.

Exceptions: *(Relocated from 2019 CALGreen Section 5.106.5.3.3 and edited)*

1**.** On a case-by-case basis where the local enforcing agency has determined compliance with this section is not feasible based upon one of the following conditions:

a. Where there is no local utility power supply.

b. Where the local utility is unable to supply adequate power.

c. Where there is evidence suitable to the local enforcement agency substantiating that additional local utility infrastructure design requirements, directly related to the implementation of Section 5.106.5.3, may adversely impact the construction cost of the project.

2. Parking spaces accessible only by automated mechanical car parking systems are not required to comply with this code section.

3. In major alterations, where there is evidence substantiating that meeting the requirements of this section present an unreasonable hardship or are technically infeasible, the Director may upon request from the project sponsor consider an appeal to reduce the number of EV Spaces required.

TABLE 5.106.5.3.1

TOTAL NUMBER OF ACTUAL PARKING SPACES	NUMBER OF REQUIRED EV CAPABLE SPACES	NUMBER OF EVCS (EV CAPABLE SPACES PROVIDED WITH EVSE) [2]
0-4	~~0~~1	0
5-9	~~0~~2	0
10-25	4	0
26-50	8	2
51-75	13	3
76-100	17	4
101-150	25	6
151-200	35	9
201 and over	20 percent of total[1]	25 percent of EV capable spaces [1]

1. Calculation for spaces shall be rounded up to the nearest whole number.
2. The number of required EVCS (EV capable spaces provided with EVSE) in column 3 count toward the total number of required EV capable spaces shown in column 2.

~~**5.106.5.3 Electric vehicle (EV) charging.** In new construction and major alterations, 100% of off-street parking spaces in buildings and facilities provided for passenger vehicles and trucks shall be EV Spaces capable of supporting future EVSE. Electrical engineering design and construction documents shall indicate the location of all proposed EV spaces. When EVSE is installed, it shall be in accordance with the San Francisco Building Code and the San Francisco Electrical Code~~

~~**5.106.5.3.1 Single charging space requirements.** When a single EV Space is required per Section 5.106.5.3.3, install a full branch circuit with a minimum of 40-Amp 208 or 240 Volt capacity, including listed raceway, electrical panel capacity, overcurrent protection devices, wire, and suitable listed termination point such as a receptacle. The termination point shall be in close proximity to the proposed EV charger location. The raceway shall not be less than trade size 1 (nominal 1-inch inside diameter). The circuit shall be installed~~

in accordance with the San Francisco Electrical Code and the San Francisco Building Code.

5.106.5.3.2 Multiple Charging Space Requirements

(a) For a minimum of 10% of EV Spaces, and in no case less than two EV spaces when the total number of EV Spaces is two or more, install a full circuit with minimum of 40-Amp 208 or 240 Volt capacity per EV Space, including listed raceway, sufficient electrical panel service capacity, overcurrent protection devices, wire, and suitable listed termination point such as a receptacle. The termination point shall be in close proximity to the proposed EV charger location. Calculations for the number of EV Spaces shall be rounded up to the nearest whole number. [N]

(b) Branch circuit panelboard(s) shall be installed at each parking level with service capacity to deliver a minimum 40 amperes at 208 or 240 volts multiplied by 20% of the total number of EV Spaces. The panelboard(s) shall have sufficient space to install a minimum of one 40-ampere dedicated branch circuit and overcurrent protective device per EV Space up to a minimum of 20% of the total number of EV Spaces. The circuits and overcurrent protective devices shall remain reserved for exclusive use by electric vehicle charging.

(c) For all EV Spaces not required to install full circuits or raceways per Section 5.106.5.3.2(a):

(1) Either:

(A) Provide space for future installation of additional electrical panelboards to support a 40 ampere 208 or 240 Volt capacity branch circuit and overcurrent protection device per EV Space, or equivalent consistent with Section 5.106.5.3.2.1; or

(B) Provide space in installed electrical panelboard(s) to support installation of a 40 ampere 208 or 240 volt capacity branch circuit and overcurrent protection device per EV Space, or equivalent consistent with Section 5.106.5.3.2.1.

(2) Install raceway or sleeves where penetrations to walls, floors, or other partitions will be necessary to install panels, raceways, or related electrical components necessary for future installation of branch circuits. All such penetrations must comply with applicable codes, including but not limited to the San Francisco Electrical Code and the San Francisco Fire Code.

(d) Construction documents, including electrical engineering and design related documents, shall demonstrate the electrical service capacity of the electrical system, including any on-site distribution transformer(s), can charge EVSE at a minimum of 20% of the total number of EV Spaces simultaneously, at the full rated amperage of the EVSE or a minimum of 40 amperes per branch circuit, whichever is greater. As appropriate, construction documents shall provide information on raceway method(s), wiring schematics, anticipated EV load management system design(s), and electrical load calculations.

Exceptions.

1. Where there is no commercial power supply.

2. Where there is evidence substantiating that meeting the requirements will alter the local utility infrastructure design requirements directly related to the implementation of this Section may increase the utility side cost to the developer by more than $400 per parking space. In such cases, buildings subject to Section 5.106.5.3.2 shall maximize the number of EV Spaces, up to a maximum utility side cost of $400 per space. Cost shall be determined by dividing the increase in local utility infrastructure cost attributable to compliance with this section by the sum of parking spaces and Electric Vehicle Charging Spaces.

3. In major alterations, where there is evidence substantiating that meeting the requirements of this section present an unreasonable hardship or is technically infeasible, the Director may upon request from the project sponsor consider an appeal to reduce the number of EV Spaces required.

Note: This section does not require installation of EVSE.

The intent of sizing electrical service to provide 40 amperes at 208 or 240 Volts to at least 20% of spaces simultaneously is to provide the option to utilize listed EV Load Management Systems to provide Level 2 EV charging at 100% of parking spaces. A listed EV Load Management system manages the available capacity in a safe manner, such as allocating 36 amperes at 208 or 240 volts to vehicles in 20% of the total number of EV Charging Stations simultaneously, or allocating 8 amperes to vehicles in 100% of parking spaces, or similar. Given the capacity required by this Section, individual EV chargers may be installed in up to 20% of parking spaces before an EV load management system is necessary.

5.106.5.3.2.1 Electric vehicle (EV) fast charging spaces.

(a) Installation of one EV Fast Charger may reduce the number of EV Spaces required under Section 5.106.5.3.2(a) by up to 10 EV Spaces, provided the project includes at least one EV Space equipped with a

full circuit able to deliver 40 Amps at 208 or 240 volts to the EV Space, including listed raceway, sufficient electrical panel capacity, overcurrent protection devices, wire, and suitable listed termination point such as a receptacle.

The electrical panel board(s) provided at each parking level served by EV Fast Chargers shall have sufficient capacity to supply each Electric Vehicle fast charger with a minimum of 30 kW AC in addition to the capacity to serve any remaining EV spaces with a minimum of 8 amperes at 208 or 240 volts per EV Space simultaneously, with a minimum of 40 amperes per circuit.

(b) After the requirements of 5.106.5.3.2(a) and (b) are met, each planned EV Fast Charger may reduce the number of planned EV Spaces required under 5.106.5.3.2(c) by up to 10 spaces. Electrical engineering design and construction documents shall indicate the raceway termination point and proposed location of future EV Fast Charger Spaces and EV Fast Chargers. Electrical engineering design and construction documents shall also provide information on amperage of EV Fast Chargers, raceway method(s), and wiring schematics. Electrical engineering design and construction documents shall also provide electrical load calculations to verify that the electrical panel service capacity and electrical system has sufficient capacity to simultaneously operate all installed EV Fast Chargers with the full rated amperage of the EV fast charger(s), and simultaneously serve a minimum of 40 amps per branch circuit to any remaining EV spaces required by Section 5.106.5.3.2(a). Raceways and related components that are planned to be installed in underground, enclosed, inaccessible, or otherwise concealed areas or spaces, shall be installed at the time of original construction.

5.106.5.3.3 EV Space slope, dimensions, and location. Design and construction documents shall indicate how many accessible EVCS would be required under Title 24 Chapter 11B Table 11B-228.3.2.1, if applicable, in order to convert all EV Spaces required under 5.106.5.3.2 to EVCS, excluding the exceptions in 5.106.5.3.2. Design and construction documents shall also demonstrate that the facility is designed so that compliance with accessibility standards will be feasible for accessible EV Spaces at the time of EVCS installation. Surface slope for any area designated for accessible EV Spaces shall meet slope requirements in section 11B-812.3 at the time of original building construction and vertical clearance requirements in Section 11B-812-4, if applicable.

Exception: Accessibility requirements of Section 5.106.5.3.3 shall not apply to buildings that are not covered under Title 24 Part 2 Chapter 11B. In addition, all applicable exceptions to Chapter 11B shall apply to this Section 5.106.5.3.3.

Note: Section 5.106.5.3.3, above, requires that the project be prepared to comply with accessibility requirements applicable at the time of EVSE installation. Section 11B-812 of the 2019 California Building Code requires that a facility providing EVCS for public and common use also provide one or more accessibility EVCS as specified in Table 11B-228.3.2.1. Chapter 11B regulates accessibility in certain buildings and facilities, including but not limited to accessibility in public buildings, public accommodations, commercial buildings, and publicly funded housing (see section 1.9 of Part 2 of the California Building Code). Section 11B-812.4 requires that "Parking spaces, access aisles and vehicular routes serving them shall provide a vertical clearance of 98 inches (2489 mm) minimum." Section 11B-812.3 requires that parking spaces and access aisles meet maximum slope requirements of 1 unit vertical in 48 units horizontal (2.083% slope) in any direction at the time of new building construction or renovation. Section 11B-812.5 contains accessible route requirements.

5.106.5.3.4 Identification. The service panel or subpanel(s) circuit directory shall identify the reserved overcurrent protective device space(s) for future EV charging as "EVSE READY" for full circuits and otherwise "EVSE CAPABLE." The raceway termination location or receptacle shall be permanently and visibly marked as "EVSE READY" for full circuits and otherwise "EVSE CAPABLE" until such time as EVSE are installed.

Division 5.2

ENERGY EFFICIENCY

SECTION 5.201 – GENERAL

5.201 Add the following sections:

5.201.1.1 Energy performance.

(a) **All-electric buildings.** A newly constructed all-electric non-residential building shall demonstrate the Energy Budget for the proposed building is no greater than the Energy Budget calculated for the Standard Design Building meeting California Title 24 Part 6 Energy Standards.

(b) **Mixed-fuel buildings.** A newly constructed mixed-fuel non-residential building shall demonstrate the Energy Budget for the proposed building is no greater than 90% of the Title 24 Part 6 Energy Budget for the Standard Design Building meeting California Title 24 Part 6 Energy Standards.

Exception: Buildings consisting primarily of occupancy F, L, or H are exempt from this Section.

5.201.1.2. ~~Renewable energy and~~ Better roofs.

(a) California Title 24 Part 6 Energy Standards section 140.10 requires newly~~Newly~~ constructed buildings of uses noted in Table 140.10-A to install photovoltaic (PV) energy systems, and requires the minimum size of such systems to be not less than the smaller of PV direct current size determined by Equation 140.10-A, or the total of all Solar Access Roof Area (SARA) multiplied by 14 W/ft^2. ~~nonresidential occupancy which are 2000 square feet or greater in gross floor area, are of 10 or fewer occupied floors, and apply for a building permit on or after January 1, 2017~~ Projects that constitute a Large Development Project or Small Development Project under the Stormwater Management Ordinance (Public Works Code secs 147-147.6) may exclude from SARA any roof area where both:

(1) The area is occupied by living roof, meaning the area of media for growing plants, and

(2) The area occupied by living roof contributes to determination of compliance with the Stormwater Management Ordinance, as documented by a Preliminary Stormwater Control Plan or a Modified Compliance Application submitted to the San Francisco Public Utilities Commission.

(b) In any final Stormwater Control Plan approved by the San Francisco Public Utilities Commission, including where such approval may occur subsequent to addenda to a Site Permit wherein compliance with California Title 24 Part 6 Energy Standards is documented, the applicant shall ensure the area occupied by living roof contributing to determination of compliance with the Stormwater Management Ordinance is no less than the square footage approved for exclusion from SARA.

~~(b) The required solar zone area for the project shall be calculated under California Code of Regulations (CCR), Title 24, Part 6, Section 110.10(b) through (e), and Nonresidential Compliance Manual Chapter 9, as provided below:~~

~~(1) Buildings subject to Planning Code Section 149 may apply Exception 5 to Title 24, Part 6, Section 110.10(b)1B in the calculation of the minimum solar zone area and may not apply Exceptions 1, 2, 3, and 4 in the calculation.~~

~~(2) Buildings not subject to Planning Code Section 149 may apply Exceptions 3 and 5 in the calculation of the minimum solar zone area and may not apply Exceptions 1, 2, and 4 in the calculation. Such buildings with a calculated~~

~~minimum solar zone area of less than 150 contiguous square feet due to limited solar access under Exception 3 are exempt from the solar energy requirements in this Section 5.201.1.2.~~

~~(c) The sum of the areas occupied by solar photovoltaic collectors and/or solar thermal collectors must be equal to or greater than the solar zone area. The solar zone shall be located on the roof or overhang of the building, or on the roof or overhang of another structure located within 250 feet of the building or on covered parking installed with the building project. Solar photovoltaic systems and solar thermal systems shall be installed in accord with all applicable state and local code requirements, manufacturer's specifications, and the following performance requirements:~~

~~(1) Solar photovoltaic systems: The total nameplate capacity of photovoltaic collectors shall be at least 10 $Watts_{DC}$ per square foot of roof area allocated to the photovoltaic collectors.~~

~~(2) Solar thermal systems: Solar thermal systems installed to serve non-residential building occupancies shall use collectors with OG-100 Collector Certification by the Solar Rating and Certification Corporation (SRCC) or the International Association of Plumbing and Mechanical Officials (IAPMO), shall be designed to generate annually at least 100 kBtu per square foot of roof area allocated to the solar thermal collectors, and, for systems with at least 500 square feet of collector area, shall include a Btu meter installed on either the collector loop or potable water side of the solar thermal system.~~

~~(d) Approval by the Planning Department of compliance with the Better Roof requirements, including the Living Roof alternative, as provided in Planning Code Section 149, shall be accepted for compliance with San Francisco Green Building Code Section 5.201.1.2(a) through (c). The requirements of CCR Title 24, Part 6, Section 110.10 for the solar zone shall still apply.~~

~~**5.201.1.3 Renewable energy.** Permit applicants constructing new buildings of 11 floors or greater must submit documentation verifying either:~~

~~(1) Acquisition of renewable on-site energy (demonstrated via EA Credit Renewable Energy Production) or purchase of green energy credits (demonstrated via EA Credit Green Power and Carbon Offsets) OR~~

~~(2) Enhance energy efficiency (demonstrated via at least 5 LEED points under EA Credit Optimize Energy Performance) in addition to compliance with Title 24 Part 6 2019 California Energy Standards.~~

Chapter 7

INSTALLER AND SPECIAL INSPECTOR QUALIFICATIONS

SECTION 701 – GENERAL

701.1 Add the following section:

701.1 These requirements apply to installers and Special inspectors with regards to the requirements of this chapter.

SECTION 702 – QUALIFICATIONS

702.2 Modify certification number 2 as follows ~~the following section~~:

702.2 Special inspection. …

2. Certification by a statewide energy consulting or verification organization, such as HERS raters, building performance contractors, home energy auditors, and ICC Certified CALGreen Inspectors.

702.3 Add the following section:

702.3 Special inspection. The Director of the Department of Building Inspection may require special inspection to verify compliance with this code or other laws that are enforced by the agency. The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Director of the Department of Building Inspection, for inspection of the particular type of construction or operation requiring special inspection. In addition, the special inspector shall have a certification from a recognized state, national, or international association, as determined by the Director of the Department of Building Inspection. The area of certification shall be closely related to the primary job function, as determined by the local agency.

SECTION 7.703 – VERIFICATIONS

703.1 Modify the section as follows:

703.1 Documentation. Documentation used to show compliance with this code shall include but is not limited to, construction documents, plans, specifications, builder or installer certification, inspection reports,

or other methods acceptable to the Director of the Department of Building Inspection which demonstrate substantial conformance. When specific documentation or special inspection is necessary to verify compliance, that method of compliance will be specified in Administrative Bulletin 93.

Proposed 2022 San Francisco Building / Existing Building / Mechanical/ Electrical / Plumbing/ Green Building Amendments

Notable Changes List and Summary

PROPOSED SAN FRANCISCO BUILDING CODE AMENDMENTS 2022 Edition	
Section No.	**Commands/Findings:**
101A.1	Correct code year
101A.3.1	Correct parts to title 24
101A.4	Add title where there was none
102A.7	grammar
106A.1.13	Correct numbering
106A.1.14.2	Correct reference number
106A.1.15.2	Correct reference number
106A.3.2	Align with current practice
106A.3.3	Correct reference section numbering
106A.4.1.4.4	Remove redundant word
106A.4.13	Align with current practice
107A.13.7	Correct abbreviation
202	Rename definition for applicability of definition
406.3	Remove redundant language now in CBC
406.3.4	Numbering alignment with CBC
435.3.5	Write out abbreviation
903.2.8	Correct reference section numbering
907.2.9.5	Correct reference section numbering
907.2.11.2.7	Correct reference section numbering & add appropriate title
1011.5.5	Add word "inch" which is missing in measurement description
1011.5.5	Add "-" to one - and - two family ….
1011.5.5.1	Add "-" to one - and - two family ….
1011.12.3	Change numbering to be consistent with formatting

1012.2	Add "-" and "units" for clarity
1015.4	Grammar and capitalization
1016.2	Move reference to end of paragraph to be consistent with formatting
1016.3	Move reference to end of paragraph to be consistent with formatting
1005A.5	Correct section reference
1115D	Removed section as action is repealed
1202.5	Correct grammar, remove comma
1204.4	Correct word to stairway instead of stair
1206.7	Relocate title to beginning of section
1208.4	Correct section numbering to align with CBC, modify to be consistent with CBC language
1210	Section numbering update consistent with CBC
1304D	Correct spelling
1402.8	Correct numbering for SFBC consistency
1501.1	Correct code year
1505.1	Revise section to remove redundancy in CBC, first sentence
1507.8.5	Section numbering update consistent with CBC
1507.9.6	Renumber section to be consistent with CBC
1511.2.2	Renumber section to be consistent with CBC
1511.10	Renumber for consistency, add appropriate to section
1604.11	SF Heading consistency
1607.1	Relocate to next SFBC section, remove from footnote to be consistent with CBC
1607.20	Add back SF requirement striked out in 1607.1 in CBC section
1607.20.3	Realign number with CBC, add back language removed in 1607.1
1705.1.1	Correct spelling
1705.4.3	Revise to appropriate CBC section, keep CBC language and fit SFBC amendment within most appropriate section.
1705.4.4	Section numbering update
1705.5.8	Section numbering update, correct reference numbering, remove item #6 not used in CBC
1705.13.5	Fit back in language removed in 1705.4.3 to appropriate section
1705.20	Section numbering, correct grammar/language
1705.22	Section numbering update
1705.22	Section numbering update

2304.12.2.3	Correct reference numbering
2304.12.2.6.2	Correct section numbering update
2603.4.1.5	Language is outdated, revise for consistency with CBC and maintain SF Amendment intent
3010.1	Update code year
3103.1.2	Update code section
3116	Update section numbering with CBC
36	Change numbering to be consistent with CRC, add chapters as added by CRC
Appx P	Update change from O to P from CBC

PROPOSED SAN FRANCISCO EXISTING BUILDING CODE AMENDMENTS 2022 Edition

Section No.	Commands/Findings:
303.3.2	Update section numbering with CEBC
303.4.1	Update section numbering with CEBC, correct associated reference numbering
303.4.2	Update section numbering with CEBC
303.4.3	Update section numbering with CEBC
327	Remove 327.5.1-327.5.3 has sunset, update section numbering to align
405.2	Update section numbering with CEBC
405.2.3.1	Update section numbering with CEBC
501.1.3	Update reference section number
501.6	Update section numbering with CEBC
501.7	Update section numbering with CEBC
501.8	Update section numbering with CEBC
501.9	Update section numbering with CEBC
502.10	Update section numbering with CEBC
502.11	Update section numbering with CEBC
503.11.1	Update reference section number
503.19	Update section numbering with CEBC
506	To align with CEBC as current language incorrectly requires full seismic forces rather than reduced seismic forces as per State
502B	Update reference section number

506B	Update reference section number
509C	Update reference section number
Table 5C	Update reference section number
502E	Update reference section number
PROPOSED SAN FRANCISCO MECHANICAL CODE AMENDMENTS 2022 Edition	
Section No.	**Commands/Findings:**
101.1	Correct code year
PROPOSED SAN FRANCISCO ELECTRICAL CODE AMENDMENTS 2022 Edition	
Section No.	**Commands/Findings:**
89.101.1	Correct code year
89.120	Correct typo
110.26(A)(3)	Update exceptions numbers and references to align with NEC
334.12	Correct code year
700.12(I)(2)	Update Code sections to align with NEC
700.16	Update Code sections and wording
PROPOSED SAN FRANCISCO PLUMBING CODE AMENDMENTS 2022 Edition	
Section No.	**Commands/Findings:**
101.1	Correct code year
104.4.3.2	Renumber section, align with UPC
104.4.3.3	Renumber section, align with UPC
606.10	Renumber section, align with UPC
609.11.2	Renumber section, align with UPC
609.11.3	Renumber section align, with UPC

PROPOSED SAN FRANCISCO GREEN BUILDING CODE AMENDMENTS 2022 Edition	
Section No.	**Commands/Findings:**
101.2	Update to align with SF Environmental Code
101.3.1	Update to align with SF Environmental Code
101.10	Update current LEED requirement
202	Accept new state definitions and eliminate local where no longer necessary
4.103.3.1	Align LEED rating to be consistent between New Construction and Major Alteration
4.103.3.3	Remove as is captured in CalGreen
4.104.1	Update code year
4.106.4	Remove as CalGreen relocates major alteration section
4.106.4(1.2)	merge back current SFGBC language with State changes
4.106.4(3)	Remove as major alterations requirements are relocated in other parts of SFGBC and CalGreen
4.106.4(4)	Remove as major alterations requirements are relocated in other parts of SFGBC and CalGreen
4.106.4.1.1	Revise to align with CalGreen
4.106.4.2	Remove as is incorporated in CalGreen, redundant
4.106.4.2.2.1.2	Remove reference, no longer needed
4.106.4.2.3	Remove entire section, rewrite to align with state
4.106.4.2.4	Remove entire section, rewrite to align with state
4.106.4..2.4.1	Remove entire section, rewrite to align with state
4.106.4.2.4	Remove entire section, rewrite to align with state
4.201	Update to align with CA Energy Standards, rewrite to align with state and prior Better Roofs requirement
Chapter 5	Adopt Calgreen numbering
	Update to Calgreen EV requirements but retain SF EV infrastructure for major alterations

	Remove sections superseded by Calgreen
5.201.1.1	Maintain requirement for energy budget
5.201.1.2	Maintain option to install living roof instead of PV

Triennial Code Adoption

Michelle Yu, Technical Services

Oct. 17, 2022

Background

Every three years

Effective January 1, 2023

What happens:

- California state agencies review changes in the model code

  ICC, IAPMO, NEC, NFPA

- California makes amendments/additions to the 12-part California Code of Regulations

The Triennial Code Adoption Process

The San Francisco Building Code is amended and readopted every three years in accordance with the Triennial Adoption of the California State Building Standards Code

2021

2022

SAN FRANCISCO DEPARTMENT OF BUILDING INSPECTION

2023

The Triennial Code Adoption Process

SF Code Amendments

- SF Building Code
- SF Existing Building Code
- SF Mechanical Code
- SF Electrical Code
- SF Plumbing Code
- SF Green Building Code

Code Adoption Package

Proposal

- Carry forward existing SF amendments
- Administrative changes to align SF codes with state changes:
    - clean-up to fix any spelling/grammar/text
    - chapter renumbering
    - update correct references
    - remove redundancy
    - align current practice

Code Adoption Package

Formatting

- Unchanged language from the 2022 California Codes is shaded and may include bold and/or italicized formatting

- Repealed San Francisco amendments appear with ~~strikeout~~

- New San Francisco amendments appear with underline

Examples of SF Changes

Types of Change	Example
Chapter number changes	**SFBC SECTION 1511 – Rooftop structures** Updated from 1510 to 1511 – Rooftop Structures **SFBC SECTION 3116 – Wood-burning appliances** Updated from 3114 to 3116
Update Correct References	**2019 to 2022** Update all 2019 code reference to 2022 edition **SFBC 903.2.8 - CRC reference update** Correct appropriate CRC scoping reference for sprinklers from R1.1.3 to R101.2

Examples of SF Changes

Types of Change	Example
Remove redundant SF code language	**Remove SFBC SECTION 1705.4.3 Exterior Facing** Remove 1705.4.3 Exterior Facing and wove into 1705.13.5 Architectural components. Similar content
	Rewrite SFGBC 4.201.2 Rewrite to captures CA Energy Standards and weave SF requirements of better roofs requirement

Examples of SF Changes

Types of Change	Example
Align current practice	**SECTION 106A.3.2 – Submittal Documents** • Remove “original signature” which implies wet-signed • Facilitate electronic plan review
Remove Sunset	**SFEBC SECTION 327.5.1 – Notification Requirements** • Requirement has sunset: 327.5.3 – remove section and adjust numbering

THANK YOU

BOARD of SUPERVISORS

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September 21, 2022

File No. 220942

Lisa Gibson
Environmental Review Officer
Planning Department
49 South Van Ness Avenue, Suite 1400
San Francisco, CA 94103

Dear Ms. Gibson:

On September 13, 2022, Building Inspection Commission introduced the following proposed legislation:

File No. 220942

Ordinance repealing the 2019 Green Building Code in its entirety and enacting a 2022 Green Building Code consisting of the 2022 California Green Building Standards Code, as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2023; and directing the Clerk of the Board of Supervisors to forward the Ordinance to the California Building Standards Commission, as required by State law.

This legislation is being transmitted to you for environmental review.

Angela Calvillo, Clerk of the Board

By: Erica Major, Assistant Clerk
Land Use and Transportation Committee

Attachment

c: Joy Navarrete, Environmental Planning
Don Lewis, Environmental Planning