AMENDED 10.23.2020 12.34

CITY COUNCIL MEETING

TUESDAY, OCTOBER 27, 2020 – 7:00 P.M. – 11:00 PM

Please Note: Per California Executive Order N-29-20, the City Council will meet Telephone/Video Conference only.

TO PARTICIPATE - Members of the Public may join and participate in the Council meeting at https://webinar.ringcentral.com/j/1489884225

TO LISTEN to the City Council Meeting, members of the public may call 1-650-242-4929 (Meeting ID: 148 988 4225). Please note that members of the public who call in using the telephone number will **NOT** be able to provide public comments.

TO COMMENT DURING THE MEETING members of the public will need to join the meeting using the above link and have a working microphone on their device. To request to speak please use the "Raise hand" feature located at the bottom of the screen. Public testimony will be taken at the direction of the Mayor and members of the public may only comment during times allotted for public comments.

TO SUBMIT WRITTEN COMMENTS, prior to the meeting, on matters listed on the agenda email PublicComment@losaltosca.gov with the subject line in the following format:
PUBLIC COMMENT AGENDA ITEM ## - MEETING DATE.

Correspondence must be received by 2:00 p.m. on the day of the meeting to ensure it can be distributed prior to the meeting. Emails received prior to the meeting will be included in the public record. ***Please follow this link for more information on submitting written comments.***

CALL MEETING TO ORDER

REPORT ON CLOSED SESSION

ESTABLISH QUORUM

CHANGES TO THE ORDER OF THE AGENDA

SPECIAL ITEMS

A. Commission Appointments: Appoint individuals to fill vacancies on the Complete Streets Commission, Historical Commission, and Planning Commission. (A. Chelemengos)

PUBLIC COMMENTS ON ITEMS NOT ON THE AGENDA

Members of the audience may bring to the Council's attention any item that is not on the agenda. Speakers are generally given two or three minutes, at the discretion of the Mayor. Please be advised that, by law, the City Council is unable to discuss or take action on issues presented during the Public Comment Period. According to State Law (also known as "the Brown Act") items must first be noticed on the agenda before any discussion or action.

CONSENT CALENDAR

These items will be considered by one motion unless any member of the Council or audience wishes to remove an item for discussion. Any item removed from the Consent Calendar for discussion will be handled at the discretion of the Mayor.

1. Council Minutes: Approve the minutes of the October 13, 2020 Regular Meeting (A. Chelemengos)
2. Ordinance No. 2020-473: Hold Second Reading and Adoption of an Ordinance repealing and replacing Chapter 14.14 of the Los Altos Municipal Code (Accessory and Junior Dwelling Units) by adopting Zoning Text Amendment 20-0001 (G. Persicone)
3. Contract Amendment No. 2 to the Agreement between the City of Los Altos and NOVA: Authorize City Manager to execute an amendment to the Agreement for additional Construction Management Services for Hillview Community Center Redevelopment Project (P. Maslo/J. Sandoval)
4. Contract Amendment No. 3 to Professional Services Agreement with Traffic Patterns, LLC for Engineering Support.: Authorize the City Manager to execute an amendment on behalf of the City with Traffic Patterns, LLC in an amount not to exceed $283,372 to provide additional consulting services for the Engineering Services Department. (J. Sandoval)
5. Construction Contract Award: El Monte Avenue Sidewalk Gap Closure Project, TS-01038 Award contract to lowest responsible bidder (K. Kim/J. Sandoval) **Item to be deferred to November 11, 2020.**

PUBLIC HEARINGS

6. APPL 20-0002 – 126 Mt Hamilton-Review of Revised Project :Hold Public Hearing and adopt Resolution No. 2020-34 approving the revised application To Demolish An Existing Residence And Construct A New Two-Story House Consisting Of 2,740 Square Feet On The First Story, 1,206 Square Feet On The Second Story And A 2,704 Square-Foot Basement. (G. Persicone)

7. Ordinance Nos. 2020-470A, 2020-470B, 2020-470C and 2020-471 Building Electrification and Electric Vehicle Infrastructure Reach Codes: Hold Public Hearings, introduce and waive further readings of:
   - Ordinance No. 2020-470A An Ordinance Of The City Council Of The City Of Los Altos Amending Chapter 12.22 Energy Code Of Title 12 Of The Los Altos Municipal Code Relating To Amendments To The 2019 California Energy Code For All-Electric Single-Family Buildings, Multi-Family Buildings Having From Two To Nine Residential Units, And Detached Accessory Dwelling Unit Buildings;
   - Ordinance No. 2020-470B An Ordinance Of The City Council Of The City Of Los Altos Amending Chapter 12.22 Energy Code Of Title 12 Of The Los Altos Municipal Code Relating To Amendments To The 2019 California Energy Code For All-Electric Multi-Family Residential Developments Having Ten (10) Or More Units;
   - Ordinance No.2020-470C An Ordinance Of The City Council Of The City Of Los Altos Amending Chapter 12.22 Energy Code Of Title 12 Of The Los Altos Municipal Code Relating To Amendments To The 2019 California Energy Code For All-Electric Non-Residential Buildings, Scientific Laboratory Buildings, And Public Buildings; and

- Ordinance 2020-471 - An Ordinance Of The City Council Of The City Of Los Altos Amending Chapter 12.26 Green Building Standards Code Of Title 12 Of The Los Altos Municipal Code Relating To Amendments To The 2019 California Green Building Standards Code For Electric Vehicle (EV) Infrastructure (J. Biggs)

8. Park-in-Lieu Fees Resolution No. 2020-35 Park In-Lieu Fees**:** Hold Public Hearing and adopt Resolution No. 2020-35, modifying Park In-Lieu Fee on the FY 2020/21 Fee Schedule for the City of Los Altos. Proposed Los Altos Park In-Lieu Fees were calculated pursuant to Section 13.24.010 of the Los Altos Municipal Code. The updated calculations and the supporting land appraisal report were filed with the City Clerk of the City of Los Altos on September 29, 2020. (J. Sandoval)

DISCUSSION ITEMS

9. 330 Distel Circle-Memorandum of Understanding with the County of Santa Clara: Discuss and Authorize City Manager to Execute a Memorandum of Understanding between the City of Los Altos and the County of Santa Clara for an Affordable Housing Project at 330 Distel Circle
10. Contract Amendment No. 4: Authorize the City Manager to execute Contract Amendment No. 4 on behalf of the City with Noll & Tam Architects for additional construction services necessary for the Los Altos Community Center construction project in the amount of $425,863 and up to a 20% contingency amount of $85,173 on behalf of the City, should additional amendments become necessary to address future unforeseen circumstances that could arise during construction. (CF-01002.) (P. Maslo)
11. Finance Subcommittee: Discuss City Council Finance Subcommittee

INFORMATIONAL ITEM ONLY

- Tentative Council Calendar

COUNCIL/STAFF REPORTS AND DIRECTIONS ON FUTURE AGENDA ITEMS

ADJOURNMENT – 11:00 PM

(Council Norms: It will be the custom to have a recess at approximately 9:00 p.m. Prior to the recess, the Mayor shall announce whether any items will be carried over to the next meeting. The established hour after which no new items will be started is 11:00 p.m. Remaining items, however, may be considered by consensus of the Council.)

SPECIAL NOTICES TO THE PUBLIC

In compliance with the Americans with Disabilities Act, the City of Los Altos will make reasonable arrangements to ensure accessibility to this meeting. If you need special assistance to participate in this meeting, please contact the City Clerk 72 hours prior to the meeting at (650) 947-2720.

Agendas, Staff Reports and some associated documents for City Council items may be viewed on the Internet at http://www.losaltosca.gov/citycouncil/online/index.html.

All public records relating to an open session item on this agenda, which are not exempt from disclosure pursuant to the California Public Records Act, and that are distributed to a majority of the legislative body, will be available for public inspection at the Office of the City Clerk's Office, City of Los Altos, located at One North San Antonio Road, Los Altos, California at the same time that the public records are distributed or made available to the legislative body.

If you wish to provide written materials, please provide the City Clerk with **10 copies** of any document that you would

MINUTES OF THE REGULAR MEETING OF
THE CITY COUNCIL OF THE CITY OF LOS ALTOS
TUESDAY, OCTOBER 13, 2020
HELD VIA VIDEO/TELECONFERENCE

MEETING CALLED TO ORDER

At 7:26 p.m., Mayor Pepper called the meeting to order.

ESTABLISH QUORUM

Present: Mayor Pepper, Vice Mayor Fligor, Council Members Bruins, Enander and Lee Eng
Absent: None

REPORT ON CLOSED SESSION

1. Conference with Legal Counsel – Existing Litigation
   Pursuant to Government Code Section 54956.9(d)(1)
   Name of Case: *California Renters Legal Advocacy and Education Fund, San Francisco Bay Area Renters Federation, Victoria Fierce, and Sonja Trauss v. City of Los Altos, et al. Sixth District Court of Appeal Case No HO48270, County of Santa Clara Case No.* 19CV350422

2. Conference with Legal Counsel – Existing Litigation
   Pursuant to Government Code Section 54956.9(d)(1)
   Name of Case: *40 Main LLC v City of Los Altos et al.*
   Sixth District Court of Appeal, Case Number H048270 County of Santa Clara Case No. 19CV349845

3. Conference with Legal Counsel – Existing Litigation
   Pursuant to Government Code Section 54956.9(d)(1)
   Name of Case: *Satish Ramachandran v. City of Los Altos, et al.*
   United States District Court, Northern District of California
   Case No. 5:18-cv-01223-HRL

4. Conference with Legal Counsel – Existing Litigation
   Pursuant to Government Code Section 54956.9(d)(1)
   Name of Case: *Satish Ramachandran v. Best, Best and Krieger, a limited liability Partnership; Christopher Diaz; Christina Hickey; Kirk Ballard; David Kornfield; Christopher Jordan; Pamela Jacobs, and Does 1-20*
   United States District Court, Northern California District
   Case number: 5:20-cv-03963-NC

5. Public Employment: City Manager Performance Review
   Pursuant to Government Code Section 54957 (b) and 54947.6

Mayor Pepper reported that the City Council met in closed session prior to this meeting and discussed only items # 3 and # 4 - Ramachandran Case number: 5:20-cv-03963-NC and Case No. 5:18-cv-01223-HRL. She stated that there was no action taken and nothing to report.

SPECIAL ITEMS

A. Commission Appointments: Appoint individuals to fill vacancies on the Complete Streets Commission, Historical Commission, and Planning Commission.

Mayor Pepper announced that this item would be deferred to the October 27, 2020 City Council Meeting.

B. Task Force Appointments: Appoint individuals to serve on Police Task Force (A. Chelemengos)

Mayor Pepper and Vice Mayor Fligor proposed a list of 9 nominees. Discussion commenced. Each Council Member emailed the names of their 9 nominees. Deputy City Manager reported that 10 individuals had received votes from a majority of the Council, and he announced the 10 names.

Mayor Pepper moved that the following individuals be appointed to serve on the Citizen Police Task Force: Jeanine Valadez , Aradhana Sinha, Janet Corrigan, Harvey Jang, Moira Huang, Toni Moos, Robert Curtis Cole, Renee Rashid, John Fennell and that Annie Rogaski be appointed as alternate. The motion was seconded by Vice Mayor Fligor and the motion passed 5-0 with the following roll call vote:

AYES:	Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES:	None
ABSENT:	None
ABSTAIN:	None

CHANGES TO THE ORDER OF THE AGENDA

There were no changes made to the order of the agenda

PUBLIC COMMENTS ON ITEMS NOT ON THE AGENDA

The following members of the public provided comments: Roberta Phillips, Clare Luna and Ludka Nesbit.

CONSENT CALENDAR

Council Members Lee Eng and Enander removed Item # 4. *Contract Amendment No. 4 to the Agreement between the City of Los Altos, California and Noll and Tam Architects for the additional Design / Professional Consulting Services for Hillview Community Center Redevelopment Project CF-01002.*

1. Council Minutes: Approve the minutes of the September 22, 2020 Regular Meeting
2. Resolution No. 2020-36: Conflict of Interest Code: Adopt Resolution No. 2020-36 amending the City of Los Altos Conflict of Interest Code

3. Award Contract: Authorize the City Manager to execute a not-to-exceed contract with C2R Engineering, Inc., in the amount of $100,000 to provide on call sanitary sewer spot repairs and CCTV inspection service
5. Quarterly Investment Portfolio Report Quarter Ended March 31, 2020: Approve quarterly investment portfolio report for the quarter ending March 31, 2020
6. Quarterly Investment Portfolio Report Quarter Ended June 30, 2020: Approve quarterly investment portfolio report for the quarter ending June 30, 2020

Council Member Lee Eng moved to approve the Consent Calendar Items 1-3 and 5-6. The motion was seconded by Council Member Enander and the motion passed (5-0) with the following roll call vote:

AYES:	Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES:	None
ABSENT:	None
ABSTAIN:	None

PUBLIC HEARINGS

7. Repeal and Replace Chapter 14.14 of the Los Altos Municipal Code (Accessory and Junior Dwelling Units) by adopting Zoning Text Amendment 20-0001:
   Hold Public Hearing and Introduce and waive further reading of an Ordinance repealing and replacing Chapter 14.14 of the Los Altos Municipal Code (Accessory and Junior Dwelling Units) by adopting Zoning Text Amendment 20-0001

Guido Perscone, Planning Services Director, provided a staff report and answered questions from the Council.

Mayor Pepper opened the Public Hearing.

Clare Luna provided public comment.

Since there was no one else wishing to speak, Mayor Pepper closed the public Hearing.

Council Member Bruins moved that the City Council introduce and waive further reading of the proposed Ordinance No. 2020-473. The motion was seconded by Council Member Lee Eng. The motion passed 5-0 with the following roll call vote:

AYES:	Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES:	None
ABSENT:	None
ABSTAIN:	None

Council Member Bruins moved that the City Council Adopt Zoning Text Amendment 20-0001 and make the findings that the project is exempt from CEQA per Section 21080.17 of the Public Resources

Code. The motion was seconded by Council Member Lee Eng. The motion passed 5-0 with the following roll call vote:

AYES: Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES: None
ABSENT: None
ABSTAIN: None

Council Member Bruins moved that the City Council amend the Master Fee Schedule to reduce the ADU permit fees for accessory dwelling units for a period of twelve (12) months after final adoption by the City Council of the ordinance. The motion was seconded by Council Member Lee Eng. The motion passed 5-0 with the following roll call vote:

AYES: Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES: None
ABSENT: None
ABSTAIN: None

Council Member Bruins moved that the City Council direct staff to prepare an annual ADU rental income survey to be released no later than September 1st of every calendar year, and to collect said data and to report this information to State HCD for purposes of meeting the City's RHNA Housing Element figures. The motion was seconded by Council Member Lee Eng. The motion passed 5-0 with the following roll call vote:

AYES: Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES: None
ABSENT: None
ABSTAIN: None

At 9:09 p.m. Mayor Pepper called for a break. The meeting was reconvened at 9:14 p.m.

8. Los Altos Emergency Operations Center (D20-0001): Hold Public Hearing to consider the Planning Commission's recommendation for Design Review approval subject to the recommended findings and conditions of a new detached Emergency Operations Center of approximately 1,541 square feet for the Los Altos Police Department. The project is exempt from environmental review as in-fill development in accordance with Section 15332 of the California Environmental Quality Act of 1970 as amended.

Guido Perscone, Planning Services Director, provided a staff report and answered questions from the Council.

Jim Sandoval, Engineering Services Director, Sharif Etman, Administrative Services Director, and Jeff Katz, Project Architect, were called on to answer questions from the Council.

The following members of the public provided comments: Harry Guy, Jim Clark, and Roberta Phillips.

Council discussion commenced. Staff was provided feedback on the size and design.

Upon motion of Council Member Enander, seconded by Council Member Lee Eng , Council referred the matter back to staff for identification and reevaluation of the programing for the proposed building and reconsideration of the size and directed staff to work with the local Amateur Radio Operators (HAM) as well as key staff members for their input on the use and size of the building and then bring the matter back before the Council along with information on financing of the construction of the E.O.C. The motion passed 5-0 with the following roll call vote:

AYES:	Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES:	None
ABSENT:	None
ABSTAIN:	None

4. Resolution No. 2020-37 -425 First Street Modification of Design Review Approval: Hold Public Hearing to consider the request for a modification to the approved 20-unit residential project located at 425 First Street. The modification includes replacing the two-level underground parking with one level of underground parking including a mechanical parking lift system. A Categorical Exemption (Class 32 – Infill Development) was previously adopted per the California Environmental Quality Act (CEQA) and the proposed modification will not materially change the project or CEQA determination. (S. Golden)

Steve Golden, Senior Planner, provide a staff report and responded to questions from the Council.

Jeff Warmoth, applicant, answered questions from the Council.

Mayor Pepper opened the Public Hearing.

Jon Baer provided comments.
Since there was no one else wishing to speak. The Public Hearing was closed.

Council Member Bruins moved that the City Council adopt Resolution No.2020-37 Approving A Request For An Affordable Housing Development Incentive For A Development Project Modification (Mod20-0005) At 425 First Street with the addition of a condition requiring the installation of 20 Electric Vehicle charging receptables in the garage of the structure. The motion was seconded by Vice Mayor Fligor and the motion passed 5-0 with the following roll call vote:

AYES:	Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES:	None
ABSENT:	None
ABSTAIN:	None

There was council consensus to consider Agenda Item #11 next.

11. Community Center Construction Financing: Authorize the City Manager and Council to pursue an agreement for a $10M loan on behalf of the City with Sterling National Bank. Staff will return to Council with the final agreement and resolution for approval.

Sharif Etman, Administrative Services Manager, provided a report to the Council and answered questions.

Council Member Lee Eng moved that the City Council Authorize the City Manager to pursue an agreement for a $10M loan on behalf of the City with Sterling National Bank. And to return to Council with the final agreement and resolution for approval. The motion was seconded by Mayor Pepper and the motion passed 5-0 with the following roll call vote:

AYES:	Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES:	None
ABSENT:	None
ABSTAIN:	None

Due to the late hour the following matter were deferred to the October 27, 2020 City Council Meeting:

Consent Calendar Item #4 Contract Amendment No. 4 to the Agreement between the City of Los Altos, California and Noll and Tam Architects for the additional Design / Professional Consulting Services for Hillview Community Center Redevelopment Project CF-01002.

Discussion Item #12 Tentative Council Calendar: Quarterly Review of Tentative City Council Work Calendar were deferred to the October 27th meeting.

10. Resolution No. 2020-35 Park In-Lieu Fees: Hold Public Hearing and adopt Resolution No. 2020-35, modifying Park In-Lieu Fee on the FY 2020/21 Fee Schedule for the City of Los Altos. Proposed Los Altos Park In-Lieu Fees were calculated pursuant to Section 13.24.010 of the Los Altos Municipal Code. The updated calculations and the supporting land appraisal report were filed with the City Clerk of the City of Los Altos on September 29, 2020.

Council Member Enander moved the City Council continue the Public Hearing on the matter of the Park In-Lieu Fees to the meeting of October 27, 2020. The motion was seconded by Council Member Bruins and the motion passed 5-0 with the following roll call vote:

AYES:	Council Members Bruins, Enander, Lee Eng, Vice Mayor Fligor, and Mayor Pepper.
NOES:	None
ABSENT:	None
ABSTAIN:	None

INFORMATIONAL ITEMS ONLY

- Legislative Update: Discuss pending legislation and direct staff accordingly
- Quarterly Report on City Manager approved contracts between $50,000-75,000

There was no discussion on the informational items.

COUNCIL/STAFF REPORTS AND DIRECTIONS ON FUTURE AGENDA ITEMS

Council Member Lee Eng, Enander and Bruins supported placement of the matter of a Finance Ad Hoc committee for discussion on the next agenda.

Council Members reported on their various Commission/Committee assignments.

City Manager Jordan reported on administrative matters

ADJOURNMENT

At 12:34 a.m., October 14, 2020, Mayor Pepper adjourned the meeting.

Janis C. Pepper, MAYOR

Andrea M. Chelemengos MMC, CITY CLERK

CONSENT CALENDAR

Agenda Item # 2

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Repeal and Replace Chapter 14.14 of the Los Altos Municipal Code (Accessory and Junior Dwelling Units) by adopting Zoning Text Amendment 20-0001

Prepared by: Guido F. Persicone, Planning Services Manager, AICP
Erik Ramakrishnan, Deputy City Attorney

Reviewed by: Jon Biggs, Community Development Director and
Jolie Houston, City Attorney

Attachment(s):

1. Draft ADU Ordinance-Marked Up Version
2. Draft ADU Ordinance-Clean Version

Initiated by:
City staff due to recent changes to state law.

Previous Council Consideration:
October 13, 2020

Fiscal Impact:
No direct fiscal impact is anticipated.

Environmental Review:
Adoption of an accessory dwelling unit ordinance is subject to a statutory exemption from environmental review (Public Resource Code Section 15282(h)). In addition, the action being considered does not constitute a "project" within the meaning of the California Environmental Quality Act ("CEQA") pursuant to CEQA Guidelines Section 15061(b)(3) as the activity is covered by the general rule that CEQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA. Projects that are subject to the ADU regulations will be evaluated pursuant to CEQA on an individual basis. However, ADUs are generally exempt from CEQA review under CEQA Guidelines Section 15268 (Ministerial Projects, Section 15301 (Existing Facilities), and/or Section 15303 (New Construction or Conversion of Small Structures).

Policy Question(s) for Council Consideration:

- Do the proposed code amendments ensure the Los Altos Municipal Code is consistent with recent changes to state law?

Subject: Proposed Amendments to the Chapter 14.14 (Accessory Dwelling Unit) Ordinance Second Planning Commission Meeting

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Summary:

- The ordinance repeals and replaces Chapter 14.14, Accessory Dwelling Units, to ensure consistency with State law.

Staff Recommendation:

The Planning Commission and staff recommend that the City Council adopt the ordinance.

Purpose

The purpose of the proposed amendments is to ensure compliance with new state laws affecting the development of accessory dwelling units and junior accessory dwelling units in the residential zone districts of the City.

Background

On October 13, 2020, the City Council held a public hearing and voted to introduce and waive further reading of Ordinance 2020-473 subject to edits of the draft ordinance identified by councilmembers.

Los Altos General Plan Conformance

General Plan Land Use Goal 2: Review and amend (as needed) the Zoning Ordinance to provide consistency with new state legislation and court decisions. Consider Zoning Ordinance amendments that implement the use and development of goals, policies and plan objectives for the identified planning areas (Downtown, El Camino Real Corridor, and Foothill Plaza).

Housing Element Policy 4.2: The City will encourage the development of affordable second dwelling units that conform to zoning regulations.

Program 4.2.1 – Facilitate new construction of second dwelling units.

Program 4.2.2-Study the feasibility of reducing minimum lot sizes for second living units.

Options

1) Pass and adopt the draft ordinance

Advantages: Ensure compliance with new state laws.

Disadvantages: Results in less control over accessory dwelling units in Los Altos.

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2) Direct staff to make further edits to the ordinance and bring the document back for a first reading of the City Council in November

Advantages: None identified.

Recommendation

The staff recommends Option 1.

ORDINANCE NO. 2020-___

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS REPEALING AND REPLACING THE ACCESSORY DWELLING UNIT ORDINANCE AND MAKING FINDINGS OF CEQA EXEMPTION

WHEREAS, the State Legislature has found that accessory dwelling units are a necessary and valuable form of housing in California; and

WHEREAS, accessory dwelling units help diversify the City's housing stock and help provide rental units that are affordable; and

WHEREAS, accessory dwelling units offer lower cost housing to meet the needs of existing and future residents within existing neighborhoods, while respecting neighborhood character; and

WHEREAS, accessory dwelling units provide housing for family members, students, the elderly, in-home health care providers, the disabled, and others within existing neighborhoods; and

WHEREAS, it is the intent of this ordinance to allow and promote the development of accessory dwelling units; and

WHEREAS, this Ordinance implements Program 4.2.1 and Program 4.2.2 of the City's 2015-2023 Housing Element by facilitating the development of new accessory dwelling units; and

WHEREAS, this Ordinance is exempt from environmental review pursuant to Section 15061 and Section 15301 of the California Environmental Quality Act Guidelines, as amended; and

WHEREAS, accessory dwelling units (ADUs) may contribute to achieving State and regional goals for the construction of new affordable units as defined in the Regional Housing Needs Allocation (RHNA).

NOW THEREFORE, the City Council of the City of Los Altos does hereby ordain as follows:

SECTION 1. AMENDMENT OF CODE: Chapter 14.14 of Title 14 of the Los Altos Municipal Code is hereby repealed in its entirety and replaced with the new standards and shall read as follows:

Section 14.14.010 Purpose and Intent.

The intent of this chapter is to provide for accessory dwelling units (ADUs) and junior accessory dwelling units (JADUs), collectively known as an accessory dwelling, on parcels zoned to allow single-family or multifamily dwelling residential use that include a proposed or existing dwelling. ADUs contribute needed housing to the City of Los Altos housing stock, enhance housing opportunities, and contribute to achieving the goals of the RHNA. An ADU is considered a residential use that is consistent with the existing general plan and zoning designations for the parcel. The ADU is not included in calculation of residential density for the purposes of determining general plan conformance.

14.14.020 Definitions.

As used in this section, the following terms mean:

"Accessory dwelling unit" (or "ADU") means an attached or a detached residential dwelling unit that provides complete independent living facilities and is located on a parcel with a proposed or existing residential dwelling unit. It shall include permanent provisions for living, sleeping, eating, cooking, and sanitation on the same parcel as the single-family or multi-family dwelling is or will be situated. An accessory dwelling unit also includes the following:

(A) An efficiency unit, as defined in Section 17958.1 of the Health and Safety Code.

(B) A manufactured home, as defined in Section 18007 of the Health and Safety Code.

"Accessory dwelling unit, attached" means a residential dwelling unit that is created as a result of internal conversion, addition, or combination thereof made to the primary dwelling, including attached garages, storage areas or similar uses.

"Accessory dwelling unit, detached." A detached accessory dwelling unit means an ADU that is not attached to the primary dwelling. Generally, a detached ADU is constructed as an independent structure that is surrounded by open space and located on the same parcel as the primary dwelling. However, a detached ADU may also include the conversion of an existing accessory structure that is located on the same parcel as the primary dwelling, but that is detached from the primary dwelling. In such a case, the detached ADU may be attached to another existing accessory structure.

"Existing," when referring to an existing principal dwelling, accessory structure, or other building or structure, means a building or structure erected prior to the date of adoption of the appropriate building code, or one for which a legal building permit has been issued, as defined in Section 202 of the 2019 California Building Code. An unpermitted building or structure shall not be considered "existing" for purposes of this chapter.

"Multi-family housing" means a group of dwelling units on one site that contains separate living units for two or more families that may have joined services or facilities or both.

"Junior accessory dwelling unit" (or "junior ADU" or "JADU") means a unit that is no more than 500 square feet in size, includes an efficiency kitchen consistent with building code standards, is contained entirely within the walls of a single-family residence and may include separate sanitation facilities or may share sanitation facilities with the existing structure or unit.

"Living area" means the interior habitable area of a dwelling unit, including basements and attics, if defined as habitable by the California Residential Code (CRC) but does not include a garage or any accessory structure.

"Multi-Family Residential ADU" means an ADU designed for one family and allowed under Government Code Section 65852.2(e)(1)(C), as referenced in section 14.14.070 of this Chapter.

"Nonconforming zoning condition" means a physical improvement on a parcel that does not conform with current zoning standards.

"Primary dwelling" means, (i) in the case of a parcel occupied by an existing or proposed single-family residential use, the existing or proposed primary dwelling in connection with which an ADU is proposed to be constructed, or (ii) in the case of multi-family housing, the existing or proposed multi-family use in connection with which one or more ADUs allowed under this chapter are proposed to be constructed. As used in this definition, a "single-family residential use" means a single-family residential dwelling unit that is not attached to any other dwelling unit except for an ADU, and which is designed for one family and is surrounded by open space or yards.

"Passageway". The term passageway has the meaning defined by Government Code Section 65852.2, which states: "A pathway that is unobstructed clear to the sky and extends from a street to one entrance of the accessory dwelling unit."

"Public transit" means a location, including, but not limited to, a bus stop or train station, where the public may access buses, trains, subways, and other forms of transportation that charge set fares, run on fixed routes, and/or are available to the public.

"Single Family Residential ADU" means an ADU designed for one family per 65852.2(a) of Government Code as referenced in Section 14.14.050 of this Chapter.

"Tandem parking" means that two or more automobiles are parked in any location on a parcel and lined up behind one another.

14.14.021 Standards for Categories of Single Family Residential ADUs
The following table summarizes design standards for single family residential ADUs. If this summary of information conflicts with other sections of this Chapter, those sections shall be binding. See Section 14.14.070 for design standards that apply to multi-family ADUs.

Design Standards	**JADU**	**Attached ADU (single-family)**	**Detached ADU (single-family)**
Maximum Size (see 14.14.025 for additional details)	500 sq. ft. created from the existing or proposed square footage of the primary dwelling.	1,200 sq. ft. but no more than 50% of the floor area of an existing or proposed primary dwelling (excluding basement area).	1,200 sq. ft. including basement area).
Maximum Height	NA	The greater of 16 feet or the height of the	16 feet

		underlying zoning district	
Minimum Side Setback	NA	4 feet (see exception identified within 14.14.050(f)(2))	4 feet
Minimum Rear Setback	NA	4 feet (see exception identified within 14.14.050(f)(2))	4 feet
Kitchen	Cooking appliances can include a hot plate, or counter-top cooking. A wall installed oven is not required.	Must include at least a sink, a refrigerator of no less than 10 cubic feet, and either a cooktop and an oven, or a range. A food preparation counter and storage cabinets that are of reasonable size in relation to the size of the ADU are also required.	
Parking Requirement	None	1 uncovered parking space required. See Section 14.14.050(i)(1-6) for the exceptions to this requirement.	
Owner Occupancy	Required	Not required	
Short Term Rentals	Prohibited	Prohibited	
Impact Fees	None	750 sq. ft. or less-no impact fees 751 sq. ft or more-impact fees are proportionate to principal dwelling.	
Utility Fees and Connections	None required.	The accessory dwelling may be served by the primary dwelling or may have separate utility meters.	

14.14.025 Square Footage Chart
For clarity the following chart provides the square footage thresholds for the various forms of accessory dwelling units

Unit Type	Square Footage Limitations
Efficiency Unit	The minimum size of an efficiency unit as defined by the Health and Safety Code shall be 150 square feet.
JADU	The maximum size of a JADU shall be 500 square feet created by the conversion of existing square footage of the principal dwelling unit. However, up to 150 square feet can be added to the existing structure for purposes of ingress and egress to the JADU. The additional square footage shall count towards the 500 square foot maximum.
Attached accessory dwelling unit	An **attached** single family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit~~s~~ or one thousand two hundred (1,200) square feet with more than one (1) bedroom. The total floor area for an **attached** ADU shall ~~**exclude** the~~**exclude** the basement areas, and shall not be more than fifty (50) percent of the floor area of the existing or proposed principal residence. Notwithstanding this 50% threshold requirement, an attached ADU of 850 square feet or smaller cannot be denied. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district.
Detached accessory dwelling unit	(1) A **detached** single-family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit~~s~~, or one thousand two-hundred (1,200) square feet with more than one (1) bedroom. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district. For detached accessory dwelling units, garage area **is excluded** but basement areas **are included** in the square footage calculation for the ADU.
Accessory dwelling unit subject to objective design standards	An ADU between 851-1,200 square feet is subject to a zoning clearance review for objective design standards as identified in Chapter 14.06-Chapter 14.16-24. An ADU may exceed 850 square feet only if the parcel has not exceeded the floor area ratio allowed for the parcel per Chapter 14.06 of the Los Altos Municipal Code.

Section 14.14.030 Location Permitted

A. ADUs may be permitted in the following zones: on parcels zoned for multifamily or single-family dwellings.

B. Nothing in this chapter shall be construed to authorize construction of new single-family residences in multiple-family districts where such single-family residential use is not otherwise allowed.

14.14.040 General Requirements.

Notwithstanding any local ordinance regulating the issuance of variances or special use permits, or regulations adopted herein to the contrary, an application to construct an ADU shall be approved or denied ministerially, without discretionary review or hearing, within sixty (60) days from the date the city receives a completed planning application if there is an existing single-family or multifamily structure on the parcel. The following requirements apply to all accessory dwellings:

(a) An ADU shall not be rented for periods less than thirty (30) days. Short term rentals are prohibited pursuant to Chapter 14.30 of the Los Altos Municipal Code.

(b) Except as allowed by State law, an ADU shall not be sold or have its title transferred separately from the primary dwelling.

(c) Deed Restriction. Prior to the issuance of the building permit for the ADU, the owner must record a deed restriction stating that the ADU may not be rented for periods less than thirty (30) days, and that it may not be transferred or sold separate from the primary dwelling.

(d) The installation of fire sprinklers shall not be required for an ADU if sprinklers are not required for the primary dwelling.

(e) ADUs are subject to the design standards and other zoning requirements of the zoning district in which the existing primary dwelling is located and must be built in accordance with the building code set forth in Title 12 of the Los Altos Municipal Code, except for those design, zoning, and building standards inconsistent with this chapter or with state requirements under California Government Code Section 65852.2.

(f) An ADU is not subject to residential accessory structure regulations.

(g) An ADU will not be subject to any charges and fees other than planning and building permit fees generally applicable to residential construction in the zone in which the parcel is located, except as otherwise provided herein.

(h) Any connection fees and capacity charges that may be required must be assessed in compliance with the provisions of State Government Code Section 65852.2 and 65852.22, as amended from time to time.

(i) The ADU must contain water, sewer and gas and/or electric utility connections that are in working condition upon its occupancy. The ADU may be served by the primary dwelling or may have separate utility meters. The accessory dwelling will not be considered a new residential use for the purpose of calculating connection fees or capacity charges for these utilities.

(j) An ADU must have an independent electrical sub-panel, water heating and space heating equipment within the unit or be readily accessible to the occupant on the exterior of the unit.

(k) Ministerial approval of a permit for creation of an ADU shall not be conditioned on the correction of pre-existing nonconforming zoning conditions.

(l) A certificate of occupancy for any ADU shall not be issued before the local agency issues a certificate of occupancy for the primary dwelling.

(m) If the applicant requests a delay in processing in writing, the 60-day review time shall be tolled for the period of the delay.

(n) A kitchen shall be provided for an ADU. A full kitchen requires habitable space used for preparation of food that contains at least a sink, a refrigerator of no less than 10 cubic feet, and either a cooktop and an oven, or a range. A food preparation counter and storage cabinets that are of reasonable size in relation to the size of the ADU are also required.

(o) A minimum sill height of five (5) feet ~~(60 inches)~~ for windows on the second story within fifteen (15) feet of the property line that face out to the neighbors to mitigate privacy concerns shall be required.

(p). Except as otherwise required by state law, a single-family residential ADU either attached or detached from the main house must not encroach upon the required front yard area and shall have at least a four-foot setback from the side yard property line.

14.14.050 Single-Family Residential ADU Standards in Single Family Residential Zoning Districts

Notwithstanding any other provisions of this chapter to the contrary, a single-family residential ADU shall be ~~a~~ permitted as a single-family residential use that shall comply with the following:

(a) Zoning. A single-family residential ADU shall be located on a parcel in a residential zoning district with an existing or proposed single-family residential dwelling unit.

(b) Number. For a parcel with a proposed or existing single-family dwelling, one (1) attached or detached, new construction ADU shall be permitted. In the case of a detached ADU that does not exceed 850 square feet in size nor 16 feet in height, and that provides at least four foot side and rear setbacks, the detached ADU may be established in addition to a JADU, as set forth in section 14.14.060.

(c) Relationship to Primary Dwelling. A single-family residential ADU may be within, attached to, or detached from the primary dwelling, provided that a single-family residential ADU contained within or attached to an existing primary dwelling shall have independent exterior access from the existing residence. A detached single-family residential ADU must be located at least five (5) feet from the proposed or existing primary dwelling per Section 14.14.050(f)(3).

(d) Size.

(1) A **detached** single-family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit~~s~~, or one thousand two-hundred (1,200) square feet with more than one (1) bedroom. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district. For detached accessory dwelling units, garage area **is excluded** but basement areas **are included** in the square footage calculation for the ADU.

(2) An **attached** single family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit~~s~~ or one thousand two hundred (1,200) square feet with more than one (1) bedroom. The total floor area for an **attached** ADU shall **exclude** the basement areas and shall not be more than fifty (50) percent of the floor area of the existing or proposed principal residence. Notwithstanding this 50% threshold requirement, an attached ADU of 850 square feet or smaller cannot be denied. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district.

(3) Internal Attached ADU Conversion. - There is no size limitation on an ADU that is created exclusively by converting space within the existing primary dwelling or accessory structure. If a homeowner converts a portion of the primary dwelling for an attached ADU, nothing herein shall prevent the homeowner from replacing the square footage lost, up to 850 square feet above FAR limits, subject to the applicable design rules for the specific zoning district.

(e) Height.

(1) The maximum height for a detached single-family residential ADU shall be one-story and sixteen (16) feet.

(2) Attached single-family residential ADUs shall have a maximum ~~height equal~~height equal to the greater of (i) sixteen (16) feet, or (ii) the height limit established for the primary dwelling pursuant to applicable zoning.

(f) Setbacks. A single-family residential ADU is subject to the design criteria and zoning requirements of the district in which the existing single-family dwelling is located and as follows:

(1) An attached or detached single-family residential ADU must not encroach upon the required front yard area and shall have at least four (4) foot setbacks at the rear and side yards per state law. Applicants are encouraged to comply voluntarily with the setbacks identified within 14.14.080 of ten (10) feet from the side and rear property lines to reduce privacy impacts. An ADU that provides such ten (10) foot setback shall be removed from daylight plane restrictions.

(2) A setback of four (4) feet from the interior side and rear property lines shall be required for a newly constructed, detached or attached single-family residential ADU. No setback shall be required for converting an existing living area or accessory structure or a

structure constructed in the same location, to the same dimensions and within the same footprint as an existing structure that is converted to an ADU or to a portion of an ADU. If the existing structure to be converted is four (4) feet or less from the property line, a record of survey must be provided to the City for proof of location, setbacks, footprint, and property lines.

(3) The separation from the principal dwelling and any other accessory structure on the parcel shall be at least five (5) feet unless implementation of this requirement would prohibit the construction of an 850 square foot detached ADU, in which case this requirement shall be waived provided the ADU complies with California Building Code (CBC) requirements for separation.

(g) Detached ADU Daylight Plane

(1) No portion of an attached or detached ADU shall extend above or beyond a daylight plane as follows:

(2) The daylight plane starts at a height of eight feet at the property line and proceeds inward at a 6:12 slope. At ten (10) feet from the property line the structure can increase in height to sixteen (16) feet. All appurtenances, including chimneys, vents and antennas, shall be within the daylight plane. The daylight plane is not applied to a side or rear property line when it abuts a public alley or public street. However, the ADU daylight plane shall not be enforced if it prohibits the development of an 850 square foot ADU which is required by state law. If an applicant provides the voluntary setbacks identified in 14.14.080 of ten (10) feet for the side and rear property lines, the daylight plane provisions will not apply to the structural elements of the ADU.

(3) Daylight plane shall not be enforced for an ADU if the structure abuts a city street or alleyway in the rear of the parcel.

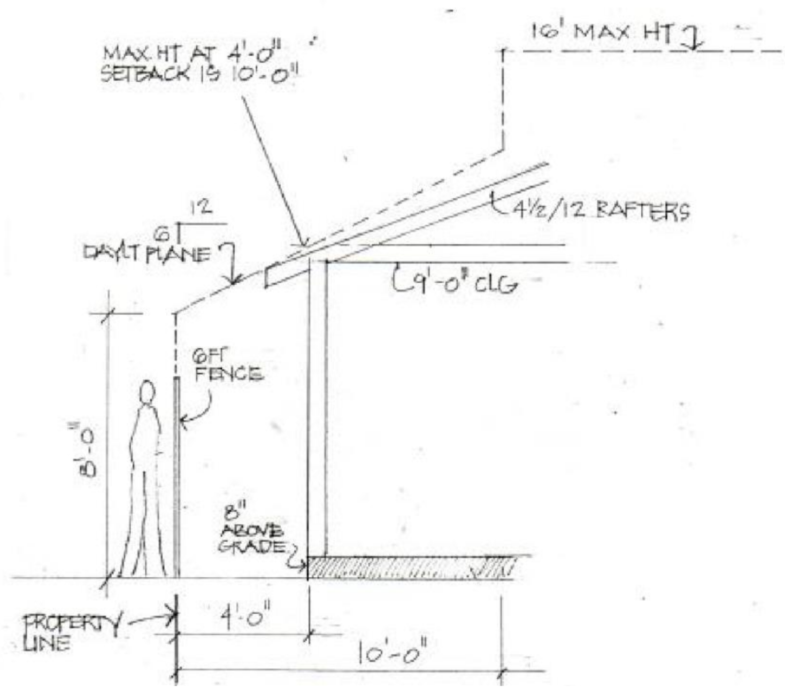

Figure 1-Standard Daylight Plane Diagram

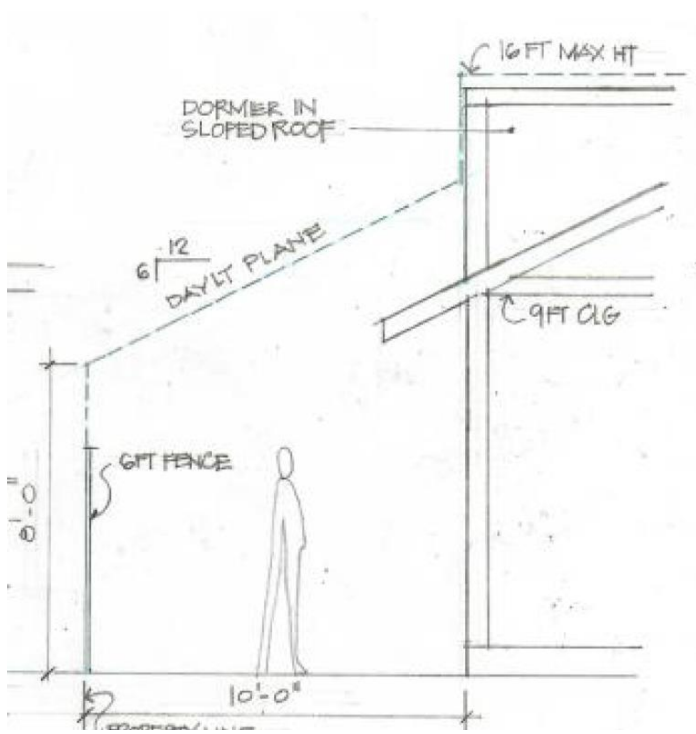

Figure 2-Voluntary Daylight Plane Diagram

(h) A single-family residential ADU must be built in accordance with the building code set forth in Title 12, except that any design, zoning, and building standards inconsistent with state requirements under California Government Code Section 65852.2 shall not apply.

(i) Parking. One (1) additional uncovered parking space of nine feet by eighteen feet (9X18) shall be required for a newly constructed single-family residential ADU, which may be located within the front setback, in tandem and in an existing driveway including within an interior side yard setback area, unless a specific finding is made that such parking is not feasible due to specific site, topographical or fire and life safety. Notwithstanding the above, a parking stall will not be required for a residential ADU that meets any of the following criteria:

(1) The single-family residential ADU is created as a result of the conversion of existing area of the single-family residence or existing permitted residential accessory structure.

(2) An existing garage, carport or parking structure is converted or demolished to accommodate a single-family residential ADU in the same location.

(3) The single-family residential ADU is within one-half (1/2) mile walking distance of a public transit station, such as a bus stop or train station.

(4) The parcel is within an architecturally and historically significant historic district.

(5) On-street parking permits are required in the area but not offered to the occupant of the residential ADU.

(6) A vehicle share site is located within one (1) block of the single-family residential ADU.

(j) Design Standards. Architectural review of attached or detached single-family residential ADUs over 850 square feet or greater will be limited to the following:

(1) Notwithstanding any other provision of this code, a zoning clearance letter shall be issued for ADUs and shall be reviewed by the director of community development or their designee for compliance with objective design standards as identified within Chapter 14.06(Single Family Zoning Districts) or Chapters 14.16-14.24 (Multi Family Zoning Districts). The permit shall be considered ministerial without discretionary review within the time frames required by Section 65852.2 of the Government Code;

(2) In those instances where an applicant seeks permission to deviate from the standards, a variance shall be filed in accordance with 14.76.070.

(3) If the permit application to create an ADU or a JADU is submitted with a permit application to create a new single-family dwelling on the parcel, the City may delay acting on the permit application for the ADU or the JADU until the permitting agency acts on the permit application to create the new single-family dwelling, but the application to create the ADU or JADU shall be considered without discretionary review or hearing. If the applicant requests a delay in writing, the 60-day time period shall be tolled for the period of the delay.

(4) The architectural features, window styles, roof slopes, exterior materials, colors, appearance, and design of the single-family residential ADU must be compatible with the existing single-family dwelling.

(5) Minimum sill height of five (5) feet for windows on the second story within fifteen (15) feet of the property line that face out to the neighbors to try to mitigate privacy concerns shall be required.

(6) A new single-family residential ADU located within a historic site or neighborhood combining district will be subject to ministerial review for compliance with the design review criteria set forth in ~~section~~ Chapter 12.44 of the Los Altos Municipal Code and must be consistent with the Secretary of Interior's Standards for the Treatment of Historic Properties.

(7) Outside stairways serving a second story single-family residential ADU shall not be constructed on any building elevation facing a public street.

(8) No passageway will be required in conjunction with the construction of any single-family residential ADU.

(k) Streamlined Approval of Accessory Dwelling Units. Notwithstanding the restrictions above, a building permit application for a detached, single-family residential ADU within a residential or mixed-use zone must be ~~a ministerial~~ approved ministerially if it is:

(1) Setback at least four (4) feet from the interior side and rear property lines. Four feet setbacks are the maximum the City can recommend per state law, but applicants are encouraged to voluntarily comply with the setbacks identified within 14.14.080 of ten (10) feet from the side and rear property lines so as to reduce privacy impacts.

(2) No larger than eight hundred and fifty (850) square feet in floor area; and

(3) No taller than sixteen (16) feet in height.

(l) Annual Rental Data. On an annual basis property owner shall be requested to submit voluntarily rental data for use by the City for the Regional Housing Needs Allocation process.

(m) Mechanical equipment and air conditioning units for accessory dwelling units shall comply with the noise thresholds identified within Chapter 6.16 of the Noise Control Ordinance.

14.14.060 JADU or EFFICENCY UNIT Standards

Notwithstanding any other provisions in this Article or of this chapter to the contrary, a JADU shall be permitted and comply with the following:

(a) The owner shall reside in the primary dwelling or the JADU

(b) One (1) JADU may be permitted per residential parcel zoned for a single-family residential use, provided that the parcel has not more than one (1) existing or proposed single-family residence. A single-family residential parcel may have both one (1) JADU and one (1) detached accessory dwelling unit.

(c) The unit must be constructed within the existing walls of a single-family dwelling except that an expansion of one hundred fifty (150) square feet beyond the existing physical dimensions of the primary dwelling may be permitted to accommodate required ingress and egress.

(d) The square footage of the unit shall be at least the minimum size (150 square feet) required for an efficiency unit, up to a maximum size of five hundred (500) square feet in floor area, and must include one (1) bedroom or studio sleeping area pursuant to Section 17958.1 of the Health and Safety Code.

(e) A separate entrance from the unit to the exterior of the residence, and an interior connection to the main living area may be provided. A second interior doorway for sound attenuation may also be permitted.

(g) At least an efficiency kitchen must be provided in the unit which shall include all the following:

(1) A cooking facility with appliances. Appliances can include hot plate, or counter-top cooking. A property owner does not need to have a wall installed oven or stove to qualify for a cooking appliance.

(2) A food preparation counter and storage cabinets that are of reasonable size in relation to the size of the JADU.

(h) The unit may include separate bathroom facilities or may share bathroom facilities contained within the primary dwelling.

(i) No separate utility connection, connection fee or capacity charge, or parking space shall be required for a JADU.

(j) A deed restriction shall be required for JADU and must include the following stipulations:

(1) prohibition on the sale of the JADU separate from the sale of the primary dwelling.

(2) if a JADU is rented, the unit shall not be rented for a period of less than thirty (30) consecutive days.

(3) owner occupancy is required for the JADU or the main house, unless the owner is another government agency, land trust or housing organization as allowed by State Law.

~~(k) Annual Rental Data. On an annual basis property owner shall be requested to submit voluntarily rental data for use by the City for the Regional Housing Needs Allocation process.~~

14.14.070 Multi Family ADU Standards in Multi Family Zoning Districts)

Notwithstanding any other provisions of this chapter to the contrary, multi-family ADUs shall be permitted and comply with the following:

(a) In addition to the types of ADUs allowed by this Section, one (1) Single-Family Residential ADU may be constructed on a parcel with a multi-family housing development project.

(b) Portions of existing multi-family dwelling structures that are not used as livable space (including, but not limited to, storage rooms, boiler rooms, passageways, attics, basements, or garages), may be converted for use as ADUs provided that total number of units must not exceed twenty-five (25) percent of the existing multi-family dwelling units or one (1) unit, whichever is greater.

(c) An owner may also construct up to a maximum of two (2) detached ADUs on a parcel that has an existing multifamily dwelling, subject to a height limit of sixteen (16) feet and at least four (4) foot rear yard and side setbacks. If there are inconsistencies between this Chapter and other provisions of the Los Altos municipal code, this Chapter shall prevail over those other provisions.

(d) ADUs in multi-family zone districts shall comply with Government Code Section 65852.2.

~~(e) Annual Rental Data. On an annual basis property owner shall be requested to submit voluntarily rental data for use by the City for the City's Regional Housing Needs Allocation process.~~

14.14.080 Voluntary Additional Setback
For a detached accessory dwelling unit, the minimum setbacks shall be five (5) feet ~~(5)~~ from the primary dwelling, and four (4) feet ~~(4)~~ from the side and rear property lines. ~~However, to~~However, to reduce the privacy impacts to abutting property owners, applicants are encouraged to voluntarily increases the setbacks to be ten (10) feet from the rear and interior property lines. If an applicant provides the ten (10) foot rear and side property line setbacks, the daylight plane provisions will not be enforced for detached accessory dwelling units.

14.14.090 ADU Rental Income Survey
Each year the City will send out an annual ADU rental income survey to be released no later than September 1st of every calendar year. The property owner can voluntarily share the rental income for the unit. Pursuant to California Constitution Article I, Section 1 and Government Code Sections 6254(k) and 6255, to protect the privacy of property owners and renters and to encourage voluntary responsiveness, the aggregated data will be ~~provided~~ used for the exclusive use of the City to meet its regional housing needs allocation (RHNA). The unredacted data will not be shared with outside agencies, persons or corporations unless specifically mandated by state or federal law.

SECTION 2. CONSTITUTIONALITY. If any section, subsection, sentence, clause or phrase of this code is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

SECTION 3. CEQA. The City Council finds the adoption of this ordinance to be statutorily exempt from the requirements of the California Environmental Quality Act (CEQA) pursuant to Section 21080.17 of the Public Resources Code because it is an ordinance regarding second units in single-family and multifamily residential zones to implement the provisions of Government Code Section 65852.2.

SECTION 4. PUBLICATION. This ordinance shall be published as provided in Government Code section 36933. Within 15 days of the passage of this ordinance, the City Clerk shall cause the full text of the ordinance, with the names of those City Council members voting for and against the ordinance, to be published in an adjudicated newspaper. In lieu of publishing the full text of the ordinance, the City Clerk, if so directed by the City Attorney and within 15 days, shall cause a summary of the ordinance, prepared by the City Attorney and with the names of the City Council members voting for and against the ordinance, to be published in an adjudicated newspaper, and shall post in the office of the City Clerk a certified copy of the full text of the ordinance, along with the names of those City Council members voting for and against the ordinance. The publication of a summary of the ordinance in lieu of the full text of the ordinance is authorized only where the requirements of Government Code Section 36933(c)(1) are met.

SECTION 5. EFFECTIVE DATE. This ordinance shall be effective upon the commencement of the thirty-first day following the adoption date.

SECTION 6. TRANSMISSION TO HCD. The City Clerk shall send a certified copy of this ordinance to the Department of Housing and Community Development (HCD) within sixty (60) days after adoption, as required by state law.

The foregoing ordinance was duly and properly introduced at a regular meeting of the City Council of the City of Los Altos held on ____________, 2020 and was thereafter, at a regular meeting held on ___________, 2020 passed and adopted by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

____
Jan Pepper, Mayor

ATTEST

____
Andrea Chelemengos MMC, City Clerk

ORDINANCE NO. 2020-473

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS REPEALING AND REPLACING THE ACCESSORY DWELLING UNIT ORDINANCE AND MAKING FINDINGS OF CEQA EXEMPTION

WHEREAS, the State Legislature has found that accessory dwelling units are a necessary and valuable form of housing in California; and

WHEREAS, accessory dwelling units help diversify the City's housing stock and help provide rental units that are affordable; and

WHEREAS, accessory dwelling units offer lower cost housing to meet the needs of existing and future residents within existing neighborhoods, while respecting neighborhood character; and

WHEREAS, accessory dwelling units provide housing for family members, students, the elderly, in-home health care providers, the disabled, and others within existing neighborhoods; and

WHEREAS, it is the intent of this ordinance to allow and promote the development of accessory dwelling units; and

WHEREAS, this Ordinance implements Program 4.2.1 and Program 4.2.2 of the City's 2015-2023 Housing Element by facilitating the development of new accessory dwelling units; and

WHEREAS, this Ordinance is exempt from environmental review pursuant to Section 15061 and Section 15301 of the California Environmental Quality Act Guidelines, as amended; and

WHEREAS, accessory dwelling units (ADUs) may contribute to achieving State and regional goals for the construction of new affordable units as defined in the Regional Housing Needs Allocation (RHNA).

NOW THEREFORE, the City Council of the City of Los Altos does hereby ordain as follows:

SECTION 1. AMENDMENT OF CODE: Chapter 14.14 of Title 14 of the Los Altos Municipal Code is hereby repealed in its entirety and replaced with the new standards and shall read as follows:

Section 14.14.010 Purpose and Intent.

The intent of this chapter is to provide for accessory dwelling units (ADUs) and junior accessory dwelling units (JADUs), collectively known as an accessory dwelling, on parcels zoned to allow single-family or multifamily dwelling residential use that include a proposed or existing dwelling. ADUs contribute needed housing to the City of Los Altos housing stock, enhance housing opportunities, and contribute to achieving the goals of the RHNA. An ADU is considered a residential use that is consistent with the existing general plan and zoning designations for the parcel. The ADU is not included in calculation of residential density for the purposes of determining general plan conformance.

14.14.020 Definitions.

As used in this section, the following terms mean:

"Accessory dwelling unit" (or "ADU") means an attached or a detached residential dwelling unit that provides complete independent living facilities and is located on a parcel with a proposed or existing residential dwelling unit. It shall include permanent provisions for living, sleeping, eating, cooking, and sanitation on the same parcel as the single-family or multi-family dwelling is or will be situated. An accessory dwelling unit also includes the following:

(A) An efficiency unit, as defined in Section 17958.1 of the Health and Safety Code.

(B) A manufactured home, as defined in Section 18007 of the Health and Safety Code.

"Accessory dwelling unit, attached" means a residential dwelling unit that is created as a result of internal conversion, addition, or combination thereof made to the primary dwelling, including attached garages, storage areas or similar uses.

"Accessory dwelling unit, detached." A detached accessory dwelling unit means an ADU that is not attached to the primary dwelling. Generally, a detached ADU is constructed as an independent structure that is surrounded by open space and located on the same parcel as the primary dwelling. However, a detached ADU may also include the conversion of an existing accessory structure that is located on the same parcel as the primary dwelling, but that is detached from the primary dwelling. In such a case, the detached ADU may be attached to another existing accessory structure.

"Existing," when referring to an existing principal dwelling, accessory structure, or other building or structure, means a building or structure erected prior to the date of adoption of the appropriate building code, or one for which a legal building permit has been issued, as defined in Section 202 of the 2019 California Building Code. An unpermitted building or structure shall not be considered "existing" for purposes of this chapter.

"Multi-family housing" means a group of dwelling units on one site that contains separate living units for two or more families that may have joined services or facilities or both.

"Junior accessory dwelling unit" (or "junior ADU" or "JADU") means a unit that is no more than 500 square feet in size, includes an efficiency kitchen consistent with building code standards, is contained entirely within the walls of a single-family residence and may include separate sanitation facilities or may share sanitation facilities with the existing structure or unit.

"Living area" means the interior habitable area of a dwelling unit, including basements and attics, if defined as habitable by the California Residential Code (CRC) but does not include a garage or any accessory structure.

"Multi-Family Residential ADU" means an ADU designed for one family and allowed under Government Code Section 65852.2(e)(1)(C), as referenced in section 14.14.070 of this Chapter.

"Nonconforming zoning condition" means a physical improvement on a parcel that does not conform with current zoning standards.

"Primary dwelling" means, (i) in the case of a parcel occupied by an existing or proposed single-family residential use, the existing or proposed primary dwelling in connection with which an ADU is proposed to be constructed, or (ii) in the case of multi-family housing, the existing or proposed multi-family use in connection with which one or more ADUs allowed under this chapter are proposed to be constructed. As used in this definition, a "single-family residential use" means a single-family residential dwelling unit that is not attached to any other dwelling unit except for an ADU, and which is designed for one family and is surrounded by open space or yards.

"Passageway". The term passageway has the meaning defined by Government Code Section 65852.2, which states: "A pathway that is unobstructed clear to the sky and extends from a street to one entrance of the accessory dwelling unit."

"Public transit" means a location, including, but not limited to, a bus stop or train station, where the public may access buses, trains, subways, and other forms of transportation that charge set fares, run on fixed routes, and/or are available to the public.

"Single Family Residential ADU" means an ADU designed for one family per 65852.2(a) of Government Code as referenced in Section 14.14.050 of this Chapter.

"Tandem parking" means that two or more automobiles are parked in any location on a parcel and lined up behind one another.

14.14.021 Standards for Categories of Single Family Residential ADUs
The following table summarizes design standards for single family residential ADUs. If this summary of information conflicts with other sections of this Chapter, those sections shall be binding. See Section 14.14.070 for design standards that apply to multi-family ADUs.

Design Standards	**JADU**	**Attached ADU (single-family)**	**Detached ADU (single-family)**
Maximum Size (see 14.14.025 for additional details)	500 sq. ft. created from the existing or proposed square footage of the primary dwelling.	1,200 sq. ft. but no more than 50% of the floor area of an existing or proposed primary dwelling (excluding basement area).	1,200 sq. ft. including basement area).
Maximum Height	NA	The greater of 16 feet or the height of the	16 feet

		underlying zoning district	
Minimum Side Setback	NA	4 feet (see exception identified within 14.14.050(f)(2))	4 feet
Minimum Rear Setback	NA	4 feet (see exception identified within 14.14.050(f)(2))	4 feet
Kitchen	Cooking appliances can include a hot plate, or counter-top cooking. A wall installed oven is not required.	Must include at least a sink, a refrigerator of no less than 10 cubic feet, and either a cooktop and an oven, or a range. A food preparation counter and storage cabinets that are of reasonable size in relation to the size of the ADU are also required.	
Parking Requirement	None	1 uncovered parking space required. See Section 14.14.050(i)(1-6) for the exceptions to this requirement.	
Owner Occupancy	Required	Not required	
Short Term Rentals	Prohibited	Prohibited	
Impact Fees	None	750 sq. ft. or less-no impact fees 751 sq. ft or more-impact fees are proportionate to principal dwelling.	
Utility Fees and Connections	None required.	The accessory dwelling may be served by the primary dwelling or may have separate utility meters.	

14.14.025 Square Footage Chart
For clarity the following chart provides the square footage thresholds for the various forms of accessory dwelling units

Unit Type	Square Footage Limitations
Efficiency Unit	The minimum size of an efficiency unit as defined by the Health and Safety Code shall be 150 square feet.
JADU	The maximum size of a JADU shall be 500 square feet created by the conversion of existing square footage of the principal dwelling unit. However, up to 150 square feet can be added to the existing structure for purposes of ingress and egress to the JADU. The additional square footage shall count towards the 500 square foot maximum.
Attached accessory dwelling unit	An **attached** single family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit or one thousand two hundred (1,200) square feet with more than one (1) bedroom. The total floor area for an **attached** ADU shall **exclude** the basement areas, and shall not be more than fifty (50) percent of the floor area of the existing or proposed principal residence. Notwithstanding this 50% threshold requirement, an attached ADU of 850 square feet or smaller cannot be denied. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district.
Detached accessory dwelling unit	(1) A **detached** single-family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit, or one thousand two-hundred (1,200) square feet with more than one (1) bedroom. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district. For detached accessory dwelling units, garage area **is excluded** but basement areas **are included** in the square footage calculation for the ADU.
Accessory dwelling unit subject to objective design standards	An ADU between 851-1,200 square feet is subject to a zoning clearance review for objective design standards as identified in Chapter 14.06-Chapter 14.16-24. An ADU may exceed 850 square feet only if the parcel has not exceeded the floor area ratio allowed for the parcel per Chapter 14.06 of the Los Altos Municipal Code.

Section 14.14.030 Location Permitted

A. ADUs may be permitted in the following zones: on parcels zoned for multifamily or single-family dwellings.

B. Nothing in this chapter shall be construed to authorize construction of new single-family residences in multiple-family districts where such single-family residential use is not otherwise allowed.

14.14.040 General Requirements.

Notwithstanding any local ordinance regulating the issuance of variances or special use permits, or regulations adopted herein to the contrary, an application to construct an ADU shall be approved or denied ministerially, without discretionary review or hearing, within sixty (60) days from the date the city receives a completed planning application if there is an existing single-family or multifamily structure on the parcel. The following requirements apply to all accessory dwellings:

(a) An ADU shall not be rented for periods less than thirty (30) days. Short term rentals are prohibited pursuant to Chapter 14.30 of the Los Altos Municipal Code.

(b) Except as allowed by State law, an ADU shall not be sold or have its title transferred separately from the primary dwelling.

(c) Deed Restriction. Prior to the issuance of the building permit for the ADU, the owner must record a deed restriction stating that the ADU may not be rented for periods less than thirty (30) days, and that it may not be transferred or sold separate from the primary dwelling.

(d) The installation of fire sprinklers shall not be required for an ADU if sprinklers are not required for the primary dwelling.

(e) ADUs are subject to the design standards and other zoning requirements of the zoning district in which the existing primary dwelling is located and must be built in accordance with the building code set forth in Title 12 of the Los Altos Municipal Code, except for those design, zoning, and building standards inconsistent with this chapter or with state requirements under California Government Code Section 65852.2.

(f) An ADU is not subject to residential accessory structure regulations.

(g) An ADU will not be subject to any charges and fees other than planning and building permit fees generally applicable to residential construction in the zone in which the parcel is located, except as otherwise provided herein.

(h) Any connection fees and capacity charges that may be required must be assessed in compliance with the provisions of State Government Code Section 65852.2 and 65852.22, as amended from time to time.

(i) The ADU must contain water, sewer and gas and/or electric utility connections that are in working condition upon its occupancy. The ADU may be served by the primary dwelling or may have separate utility meters. The accessory dwelling will not be considered a new residential use for the purpose of calculating connection fees or capacity charges for these utilities.

(j) An ADU must have an independent electrical sub-panel, water heating and space heating equipment within the unit or be readily accessible to the occupant on the exterior of the unit.

(k) Ministerial approval of a permit for creation of an ADU shall not be conditioned on the correction of pre-existing nonconforming zoning conditions.

(l) A certificate of occupancy for any ADU shall not be issued before the local agency issues a certificate of occupancy for the primary dwelling.

(m) If the applicant requests a delay in processing in writing, the 60-day review time shall be tolled for the period of the delay.

(n) A kitchen shall be provided for an ADU. A full kitchen requires habitable space used for preparation of food that contains at least a sink, a refrigerator of no less than 10 cubic feet, and either a cooktop and an oven, or a range. A food preparation counter and storage cabinets that are of reasonable size in relation to the size of the ADU are also required.

(o) A minimum sill height of five (5) feet for windows on the second story within fifteen (15) feet of the property line that face out to the neighbors to mitigate privacy concerns shall be required.

(p). Except as otherwise required by state law, a single-family residential ADU either attached or detached from the main house must not encroach upon the required front yard area and shall have at least a four-foot setback from the side yard property line.

14.14.050 Single-Family Residential ADU Standards in Single Family Residential Zoning Districts

Notwithstanding any other provisions of this chapter to the contrary, a single-family residential ADU shall be permitted as a single-family residential use that shall comply with the following:

(a) Zoning. A single-family residential ADU shall be located on a parcel in a residential zoning district with an existing or proposed single-family residential dwelling unit.

(b) Number. For a parcel with a proposed or existing single-family dwelling, one (1) attached or detached, new construction ADU shall be permitted. In the case of a detached ADU that does not exceed 850 square feet in size nor 16 feet in height, and that provides at least four foot side and rear setbacks, the detached ADU may be established in addition to a JADU, as set forth in section 14.14.060.

(c) Relationship to Primary Dwelling. A single-family residential ADU may be within, attached to, or detached from the primary dwelling, provided that a single-family residential ADU contained within or attached to an existing primary dwelling shall have independent exterior access from the existing residence. A detached single-family residential ADU must be located at least five (5) feet from the proposed or existing primary dwelling per Section 14.14.050(f)(3).

(d) Size.

(1) A **detached** single-family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit, or one thousand two-hundred (1,200) square feet with more than one (1) bedroom. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district. For detached accessory dwelling units, garage area **is excluded** but basement areas **are included** in the square footage calculation for the ADU.

(2) An **attached** single family residential ADU shall not exceed eight hundred fifty (850) square feet in floor area for one (1) bedroom unit or one thousand two hundred (1,200) square feet with more than one (1) bedroom. The total floor area for an **attached** ADU shall **exclude** the basement areas and shall not be more than fifty (50) percent of the floor area of the existing or proposed principal residence. Notwithstanding this 50% threshold requirement, an attached ADU of 850 square feet or smaller cannot be denied. Additional square footage above 850 square feet shall not be allowed if the parcel exceeds, or, with the addition of the single-family residential ADU would exceed, the lot coverage and floor area ratio requirements for the applicable zoning district.

(3) Internal Attached ADU Conversion. - There is no size limitation on an ADU that is created exclusively by converting space within the existing primary dwelling or accessory structure. If a homeowner converts a portion of the primary dwelling for an attached ADU, nothing herein shall prevent the homeowner from replacing the square footage lost, up to 850 square feet above FAR limits, subject to the applicable design rules for the specific zoning district.

(e) Height.

(1) The maximum height for a detached single-family residential ADU shall be one-story and sixteen (16) feet.

(2) Attached single-family residential ADUs shall have a maximum height equal to the greater of (i) sixteen (16) feet, or (ii) the height limit established for the primary dwelling pursuant to applicable zoning.

(f) Setbacks. A single-family residential ADU is subject to the design criteria and zoning requirements of the district in which the existing single-family dwelling is located and as follows:

(1) An attached or detached single-family residential ADU must not encroach upon the required front yard area and shall have at least four (4) foot setbacks at the rear and side yards per state law. Applicants are encouraged to comply voluntarily with the setbacks identified within 14.14.080 of ten (10) feet from the side and rear property lines to reduce privacy impacts. An ADU that provides such ten (10) foot setback shall be removed from daylight plane restrictions.

(2) A setback of four (4) feet from the interior side and rear property lines shall be required for a newly constructed, detached or attached single-family residential ADU. No setback shall be required for converting an existing living area or accessory structure or a

structure constructed in the same location, to the same dimensions and within the same footprint as an existing structure that is converted to an ADU or to a portion of an ADU. If the existing structure to be converted is four (4) feet or less from the property line, a record of survey must be provided to the City for proof of location, setbacks, footprint, and property lines.

(3) The separation from the principal dwelling and any other accessory structure on the parcel shall be at least five (5) feet unless implementation of this requirement would prohibit the construction of an 850 square foot detached ADU, in which case this requirement shall be waived provided the ADU complies with California Building Code (CBC) requirements for separation.

(g) Detached ADU Daylight Plane

(1) No portion of an attached or detached ADU shall extend above or beyond a daylight plane as follows:

(2) The daylight plane starts at a height of eight feet at the property line and proceeds inward at a 6:12 slope. At ten (10) feet from the property line the structure can increase in height to sixteen (16) feet. All appurtenances, including chimneys, vents and antennas, shall be within the daylight plane. The daylight plane is not applied to a side or rear property line when it abuts a public alley or public street. However, the ADU daylight plane shall not be enforced if it prohibits the development of an 850 square foot ADU which is required by state law. If an applicant provides the voluntary setbacks identified in 14.14.080 of ten (10) feet for the side and rear property lines, the daylight plane provisions will not apply to the structural elements of the ADU.

(3) Daylight plane shall not be enforced for an ADU if the structure abuts a city street or alleyway in the rear of the parcel.

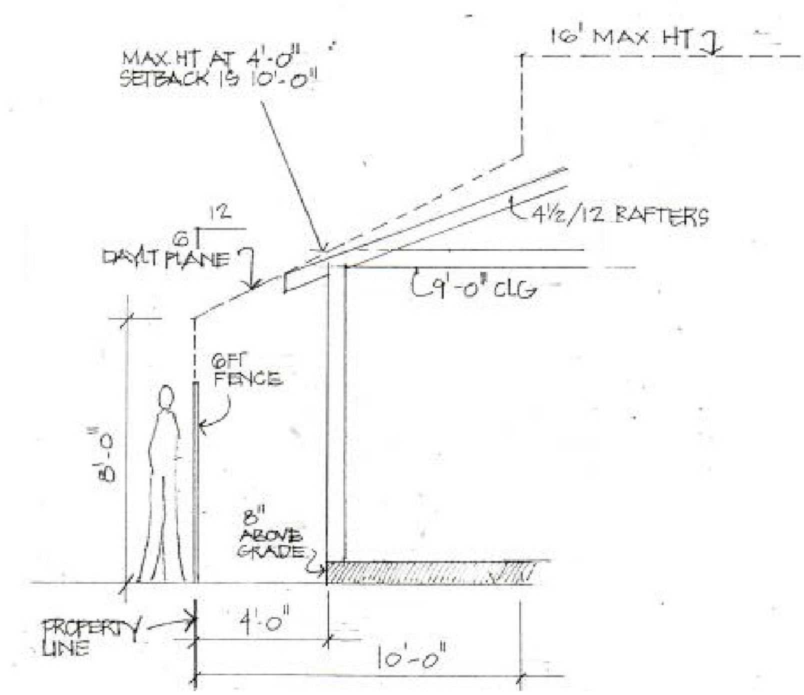

Figure 1-Standard Daylight Plane Diagram

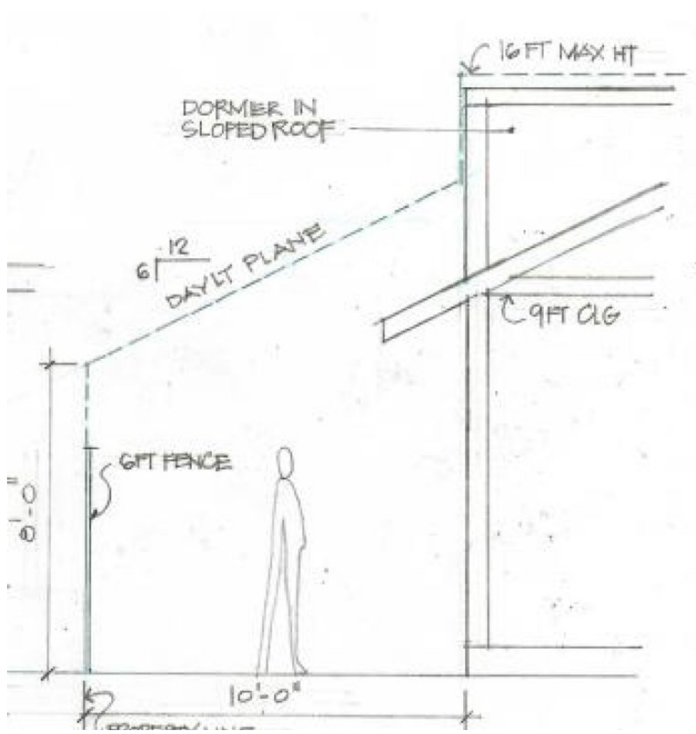

Figure 2-Voluntary Daylight Plane Diagram

(h) A single-family residential ADU must be built in accordance with the building code set forth in Title 12, except that any design, zoning, and building standards inconsistent with state requirements under California Government Code Section 65852.2 shall not apply.

(i) Parking. One (1) additional uncovered parking space of nine feet by eighteen feet (9X18) shall be required for a newly constructed single-family residential ADU, which may be located within the front setback, in tandem and in an existing driveway including within an interior side yard setback area, unless a specific finding is made that such parking is not feasible due to specific site, topographical or fire and life safety. Notwithstanding the above, a parking stall will not be required for a residential ADU that meets any of the following criteria:

(1) The single-family residential ADU is created as a result of the conversion of existing area of the single-family residence or existing permitted residential accessory structure.

(2) An existing garage, carport or parking structure is converted or demolished to accommodate a single-family residential ADU in the same location.

(3) The single-family residential ADU is within one-half (1/2) mile walking distance of a public transit station, such as a bus stop or train station.

(4) The parcel is within an architecturally and historically significant historic district.

(5) On-street parking permits are required in the area but not offered to the occupant of the residential ADU.

(6) A vehicle share site is located within one (1) block of the single-family residential ADU.

(j) Design Standards. Architectural review of attached or detached single-family residential ADUs over 850 square feet or greater will be limited to the following:

(1) Notwithstanding any other provision of this code, a zoning clearance letter shall be issued for ADUs and shall be reviewed by the director of community development or their designee for compliance with objective design standards as identified within Chapter 14.06(Single Family Zoning Districts) or Chapters 14.16-14.24 (Multi Family Zoning Districts). The permit shall be considered ministerial without discretionary review within the time frames required by Section 65852.2 of the Government Code;

(2) In those instances where an applicant seeks permission to deviate from the standards, a variance shall be filed in accordance with 14.76.070.

(3) If the permit application to create an ADU or a JADU is submitted with a permit application to create a new single-family dwelling on the parcel, the City may delay acting on the permit application for the ADU or the JADU until the permitting agency acts on the permit application to create the new single-family dwelling, but the application to create the ADU or JADU shall be considered without discretionary review or hearing. If the applicant requests a delay in writing, the 60-day time period shall be tolled for the period of the delay.

(4) The architectural features, window styles, roof slopes, exterior materials, colors, appearance, and design of the single-family residential ADU must be compatible with the existing single-family dwelling.

(5) Minimum sill height of five (5) feet for windows on the second story within fifteen (15) feet of the property line that face out to the neighbors to try to mitigate privacy concerns shall be required.

(6) A new single-family residential ADU located within a historic site or neighborhood combining district will be subject to ministerial review for compliance with the design review criteria set forth in Chapter 12.44 of the Los Altos Municipal Code and must be consistent with the Secretary of Interior's Standards for the Treatment of Historic Properties.

(7) Outside stairways serving a second story single-family residential ADU shall not be constructed on any building elevation facing a public street.

(8) No passageway will be required in conjunction with the construction of any single-family residential ADU.

(k) Streamlined Approval of Accessory Dwelling Units. Notwithstanding the restrictions above, a building permit application for a detached, single-family residential ADU within a residential or mixed-use zone must be approved ministerially if it is:

(1) Setback at least four (4) feet from the interior side and rear property lines. Four feet setbacks are the maximum the City can recommend per state law, but applicants are encouraged to voluntarily comply with the setbacks identified within 14.14.080 of ten (10) feet from the side and rear property lines so as to reduce privacy impacts.

(2) No larger than eight hundred and fifty (850) square feet in floor area; and

(3) No taller than sixteen (16) feet in height.

(l) Annual Rental Data. On an annual basis property owner shall be requested to submit voluntarily rental data for use by the City for the Regional Housing Needs Allocation process.

(m) Mechanical equipment and air conditioning units for accessory dwelling units shall comply with the noise thresholds identified within Chapter 6.16 of the Noise Control Ordinance.

14.14.060 JADU or EFFICENCY UNIT Standards

Notwithstanding any other provisions in this Article or of this chapter to the contrary, a JADU shall be permitted and comply with the following:

(a) The owner shall reside in the primary dwelling or the JADU

(b) One (1) JADU may be permitted per residential parcel zoned for a single-family residential use, provided that the parcel has not more than one (1) existing or proposed single-family residence. A single-family residential parcel may have both one (1) JADU and one (1) detached accessory dwelling unit.

(c) The unit must be constructed within the existing walls of a single-family dwelling except that an expansion of one hundred fifty (150) square feet beyond the existing physical dimensions of the primary dwelling may be permitted to accommodate required ingress and egress.

(d) The square footage of the unit shall be at least the minimum size (150 square feet) required for an efficiency unit, up to a maximum size of five hundred (500) square feet in floor area, and must include one (1) bedroom or studio sleeping area pursuant to Section 17958.1 of the Health and Safety Code.

(e) A separate entrance from the unit to the exterior of the residence, and an interior connection to the main living area may be provided. A second interior doorway for sound attenuation may also be permitted.

(g) At least an efficiency kitchen must be provided in the unit which shall include all the following:

(1) A cooking facility with appliances. Appliances can include hot plate, or counter-top cooking. A property owner does not need to have a wall installed oven or stove to qualify for a cooking appliance.

(2) A food preparation counter and storage cabinets that are of reasonable size in relation to the size of the JADU.

(h) The unit may include separate bathroom facilities or may share bathroom facilities contained within the primary dwelling.

(i) No separate utility connection, connection fee or capacity charge, or parking space shall be required for a JADU.

(j) A deed restriction shall be required for JADU and must include the following stipulations:

(1) prohibition on the sale of the JADU separate from the sale of the primary dwelling.

(2) if a JADU is rented, the unit shall not be rented for a period of less than thirty (30) consecutive days.

(3) owner occupancy is required for the JADU or the main house, unless the owner is another government agency, land trust or housing organization as allowed by State Law.

14.14.070 Multi Family ADU Standards in Multi Family Zoning Districts)

Notwithstanding any other provisions of this chapter to the contrary, multi-family ADUs shall be permitted and comply with the following:

(a) In addition to the types of ADUs allowed by this Section, one (1) Single-Family Residential ADU may be constructed on a parcel with a multi-family housing development project.

(b) Portions of existing multi-family dwelling structures that are not used as livable space (including, but not limited to, storage rooms, boiler rooms, passageways, attics, basements, or garages), may be converted for use as ADUs provided that total number of units must not exceed twenty-five (25) percent of the existing multi-family dwelling units or one (1) unit, whichever is greater.

(c) An owner may also construct up to a maximum of two (2) detached ADUs on a parcel that has an existing multifamily dwelling, subject to a height limit of sixteen (16) feet and at least four (4) foot rear yard and side setbacks. If there are inconsistencies between this Chapter and other provisions of the Los Altos municipal code, this Chapter shall prevail over those other provisions.

(d) ADUs in multi-family zone districts shall comply with Government Code Section 65852.2.

14.14.080 Voluntary Additional Setback

For a detached accessory dwelling unit, the minimum setbacks shall be five (5) feet from the primary dwelling, and four (4) feet from the side and rear property lines. However, to reduce the privacy impacts to abutting property owners, applicants are encouraged to voluntarily increases the setbacks to be ten (10) feet from the rear and interior property lines. If an applicant provides the ten (10) foot rear and side property line setbacks, the daylight plane provisions will not be enforced for detached accessory dwelling units.

14.14.090 ADU Rental Income Survey

Each year the City will send out an annual ADU rental income survey to be released no later than September 1st of every calendar year. The property owner can voluntarily share the rental income for the unit. Pursuant to California Constitution Article I, Section 1 and Government Code Sections 6254(k) and 6255, to protect the privacy of property owners and renters and to encourage voluntary responsiveness, the aggregated data will be for the exclusive use of the City to meet its regional housing needs allocation (RHNA). The unredacted data will not be shared with outside agencies, persons or corporations unless specifically mandated by state or federal law.

SECTION 2. CONSTITUTIONALITY. If any section, subsection, sentence, clause or phrase of this code is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

SECTION 3. CEQA. The City Council finds the adoption of this ordinance to be statutorily exempt from the requirements of the California Environmental Quality Act (CEQA) pursuant to Section 21080.17 of the Public Resources Code because it is an ordinance regarding second units in single-family and multifamily residential zones to implement the provisions of Government Code Section 65852.2.

SECTION 4. PUBLICATION. This ordinance shall be published as provided in Government Code section 36933. Within 15 days of the passage of this ordinance, the City Clerk shall cause the full text of the ordinance, with the names of those City Council members voting for and against the ordinance, to be published in an adjudicated newspaper. In lieu of publishing the full text of the ordinance, the City Clerk, if so directed by the City Attorney and within 15 days, shall cause a summary of the ordinance, prepared by the City Attorney and with the names of the City Council members voting for and against the ordinance, to be published in an adjudicated newspaper, and shall post in the office of the City Clerk a certified copy of the full text of the ordinance, along with the names of those City Council members voting for and against the ordinance. The publication of a summary of the ordinance in lieu of the full text of the ordinance is authorized only where the requirements of Government Code Section 36933(c)(1) are met.

SECTION 5. EFFECTIVE DATE. This ordinance shall be effective upon the commencement of the thirty-first day following the adoption date.

SECTION 6. TRANSMISSION TO HCD. The City Clerk shall send a certified copy of this ordinance to the Department of Housing and Community Development (HCD) within sixty (60) days after adoption, as required by state law.

The foregoing ordinance was duly and properly introduced at a regular meeting of the City Council of the City of Los Altos held on October 13, 2020 and was thereafter, at a regular meeting held on October 27, 2020 passed and adopted by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

Janis C. Pepper, Mayor

ATTEST

Andrea Chelemengos MMC, City Clerk

CONSENT CALENDAR

Agenda Item # 3

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Amendment No. 2 to the Agreement between the City of Los Altos, California and NOVA Partners, Inc. for the additional Construction Management Services for Hillview Community Center Redevelopment Project CF-01002.

Prepared by: Peter Maslo, Project Manager
Reviewed by: Jim Sandoval, Engineering Service Director
Approved by: Chris Jordan, City Manager

Attachment(s): NOVA Partners Amendment No. 2 Proposal

Initiated by:
Staff

Previous Council Consideration:
October 22, 2019; July 9, 2019; March 12, 2019; September 11, 2018; July 10, 2018; March 13, 2018; December 12, 2017; September 26, 2017; August 22, 2017, May 23, 2017; April 25, 2017; July 30, 2019

Fiscal Impact:
The following contract amendment will cost $241,768 and an additional 20% contingency would cost $48,354. Both costs will be funded by the $38.3M budget approved by the City Council for development of the Los Altos Community Center Project CF – 01002 in the Capital Improvement Program.

- Breakdown of funds to be used :
  - $241,768 (contract amendment) - General Fund
  - $48,354 (20% contingency) – General Fund
- Amounts already included in approved budget? Yes
- Amount above budget requested: $0

Environmental Review:
Not applicable

Policy Question(s) for Council Consideration:
- None

Summary:
- NOVA Partners is contracted with the City as the Construction Manager for the Los Altos Community Center.

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	JH	SE

- Amendment No. 2 to the Construction Management agreement with NOVA Partners is recommended by staff to extend original construction management contract from November 25, 2020 through April 2021.

Staff Recommendation
Authorize the City Manager to execute a contract amendment on behalf of the City with NOVA Partners for the additional construction management services on the Los Altos Community Center project in the amount of $241,768 and up to a 20% contingency amount of $48,354 on behalf of the City if a third amendment is necessary to further extend construction management services in Spring 2021.

Purpose
Execute an amendment for $241,768 to the existing agreement with NOVA Partners for the Los Altos Community Center Project.

Background
On July 9, 2019, City Council authorized the execution of a professional services agreement between the City of Los Altos and NOVA Partners in an amount not to exceed $938,525 for construction management services for the Community Project.

Amendment No. 1 was issued on October 22, 2019 to cover the cost for Special Testing and Inspection Services in the amount of $70,218, which included the subcontractor CONSOLIDATED ENGINEERING Laboratories' cost proposal of $63,834.40 with NOVA Partners, plus a 10% markup by NOVA Partners. Specifically, the Special Testing and Inspection Services included: Soil Testing and Observation Services, Geotechnical Engineering Services, Inspection of Reinforced Concrete, Inspection of Reinforcing Steel Placement, Monitoring and Sampling of Concrete Placement, and Concrete Compression Testing.

Discussion/Analysis
Amendment No. 2 includes necessary consulting services to complete the construction phase of the Community Center Project due to the construction schedule being extended by COVID19 and other unforeseen conditions. Currently, the projected date for Substantial Completion is March 30, 2021, which represents an approximate four months extension to the original contract completion date of November 25, 2020.

NOVA Partners will continue to provide services in accordance with the existing agreement. Tasks NOVA Partners will continue to perform during construction and project closeout shall include:

- On-site Construction Management to monitor, manage and administer all construction activities in accordance with contract requirements.

- Act as the focal point for all activities and provide coordination between the City, Architect, General Contractor and other stakeholders including City vendors (for example furniture suppliers).
- Conduct weekly construction progress meetings to coordinate and schedule activities of contractors, design professionals, City staff, and others as required. Prepare and distribute minutes of meetings.
- Coordinate and administer scheduling, sequencing, change order requests, submittals, shop drawings, inspections, testing, etc., and constructability issues among the Architect, City, and Contractor. Implement procedures for review, processing, and maintenance of project documentation, records, and decisions.
- Expeditiously resolve disputes between the construction contractor and design professionals without disruption to the project.
- Assist the City in resolving all technical, architectural, engineering, testing, surveying, scheduling, sequencing, and estimating issues, including change order cost and validity evaluation relating to design during construction.
- Conduct periodic walk-throughs and project reviews of the project with City's management, program, and project personnel.
- Direct, manage, and coordinate testing and inspection services, including monitoring and reporting to the City of actual versus estimated costs budgeted for such services through the course of the project.
- Represent or assist the City in review and resolution of disputes with the General Contractor, subcontractors, suppliers, and utilities. Maintain documentation and records on all relevant decisions and facts relating to changes, clarifications, change orders, and disputes on an ongoing basis.
- Review and provide recommendations on construction schedules submitted by the General Contractor to provide the shortest possible project completion.
- Review all progress requests for payment for amount, prevailing wage compliance, etc., and approve or modify them before forwarding to the City for payment. Review and monitor subcontractor compliance with the California Public Contract Code and report any non-compliance to the City.
- Review all project-related vendor invoices.
- Coordinate and manage the submittal and shop drawing review and approval process and advise design professionals of any unusual site conditions affecting approvals. Coordinate with the contractor to allow sufficient time for review and approval for all parties. Verify and document that the shop drawing process is proceeding according to the submittal schedule.
- Implement a field log system. This system is used for tracking requests for information (RFI), submittals, and proposed and actual change orders and their status, and manages a database which presents a chronology, including change orders completed, in progress, planned, and projected.

- Review all RFIs for completeness, clarity, and appropriateness.
- Provide analysis of change orders to include, but not be limited to, analyzing validity, analyzing contractor's estimate, determining the source of the change, analyzing and reporting on the effects of proposed and approved change orders in a timely manner.
- Maintain project budget and issue monthly updates or as requested by the City.
- Coordinate with utility companies including PG&E, Cal-Water, AT&T and Comcast as needed to ensure power, water and communications systems are installed in accordance with the City's requirements without delaying project completion.
- Coordinate with the Santa Clara County Fire Department.
- Manage close-out procedures approved by the City to accomplish timely completion of the construction contract (e.g., change orders, punch list, recommendation for acceptance, final payment, receipt of warranties and guarantees, transition to operation and maintenance phase, etc.).
- Coordinate final testing, inspections, and approvals.
- Advise the City regarding when building is ready for occupancy, when project is at the substantial and final completion stage, and when final payment is appropriate.
- Direct the initial startup, commissioning and testing of utilities, electrical and mechanical systems and equipment. Coordinate training of the City's personnel in conjunction with City's designated representatives. Collect and distribute all Operation and Maintenance manuals and warranty documentation.

The fee request by NOVA Partners for this additional scope of services to cover a period of four months is $241,768.

Options

1) Authorize the City Manager to execute an amendment with NOVA Partners for professional construction services in the amount of $241,768 and up to a 20% contingency amount of $48,354 on behalf of the City if a third amendment is necessary to further extend construction management services in Spring 2021.

Advantages: Allows construction management services to continue to manage the remaining construction activities and closeout of the Los Altos Community Center project.

Disadvantages: None.

2) Do not authorize the City Manager to execute an amendment with NOVA Partners for professional construction services in the amount of $241,768.

Advantages: None

Disadvantages: NOVA Partners will be owed funds for timely services performed that were necessary during construction and they will not be able to continue supporting the project, which puts the City in a position of significant risk from the standpoints of professional staff resources and project controls—i.e., cost and schedule oversight; construction quality assurance.

Recommendation

The staff recommends Option 1.

ATTACHMENT 1

NOVA PARTNERS INCORPORATED

October 15, 2020

Mr. Peter Maslo
City of Los Altos
1 N San Antonio Road
Los Altos, CA 94022

Subject: Los Altos Community Center Contract Amendment #2 - Construction Schedule Extension

Peter:

Nova Partners is performing Construction Management of the Los Altos Community Center (Project Number CF-01002). Due to the Covid-19 pandemic and scope modifications impacting project progress, the duration of the project has extended past the original construction contract completion date of November 25, 2020. The latest schedule shows a revised substantial completion date of March 30, 2021, an extension of approximately four months.

We are requesting to increase or contract by $241,768 to enable us to continue to manage the remaining construction activities and closeout of the project. Please reference the below fee schedule for details of our proposed fee. This amendment would enable us to continue providing services through April 2021, including approximately one month of project closeout activities.

BREAKDOWN - 4 MONTH EXTENSION							
		Principal	Sr. PM	PM	APM	Admin	
	2021 Rate	$226	$204	$187	$171	$143	Total
Month 1	Hours	9	52	173	87	4	
Month 2	Hours	9	52	173	87	4	
Month 3	Hours	9	52	173	87	4	
Month 4	Hours	9	52	173	87	4	
Total Fee		$8,136	$42,432	$129,404	$59,508	$2,288	$241,768

If you have any questions, please do not hesitate to contact us to discuss this request further.

Joe Capps-Jenner
Nova Partners, Inc.

Cc: David Marks

CONSENT CALENDAR

Agenda Item # 4

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Contract Amendment: Professional Services Agreement with Traffic Patterns, LLC for Engineering Support

Prepared by: Jim Sandoval, Interim Engineering Services Director
Approved by: Chris Jordan, City Manager

Attachment(s):
1. Traffic Patterns October 21,2020 *Work Scope for On-Call Traffic Engineering & Transportation Planning Services*

Initiated by:
Staff

Previous Council Consideration:
Not applicable

Fiscal Impact:
The proposed scope of work is estimated to cost $283,372. Sufficient funds are available in the Engineering Services Department's Traffic Operations Professional Services Budget (11400-5270).

- Breakdown of funds to be used:
  - $283,372 General Fund--Traffic Operations Professional Services (11400-5270) budget
- Amount already included in approved budget? Yes
- Amount above budget requested: $0

Environmental Review:
Not applicable

Policy Question(s) for Council Consideration:
None

Summary:
- Continued assistance for the Engineering Services Department is needed for on-call traffic engineering and transportation planning services, including acting as the City's Interim Transportation Services Manager
- Traffic Patterns has been successfully assisting the City with project management and various tasks for the Transportation Services Division since February 7, 2019

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	CD	SE

Subject: Amendment No. 3 to Professional Services Agreement with Traffic Patterns, LLC for Engineering Support

Staff Recommendation:
Authorize the City Manager to execute an amendment on behalf of the City with Traffic Patterns, LLC in an amount not to exceed $283,372 to provide additional consulting services for the Engineering Services Department.

Subject: Amendment No. 3 to Professional Services Agreement with Traffic Patterns, LLC for Engineering Support

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Purpose

Contract amendment for additional on-call traffic engineering and transportation planning consulting services for the Engineering Services Department.

Background

The agreement with Traffic Patterns, LLC was executed on February 7, 2019 in an amount not to exceed $70,000 to support City staff with various engineering and transportations tasks during the staff shortage. Traffic Patterns continued to provide support through 2019 and 2020 on tasks including but not limited to project management, traffic operation investigations, serving as the Interim Transportation Services Manager and Complete Streets Commission liaison, traffic signal management, and transportation planning and design support.

Discussion/Analysis

Traffic Patterns has been successfully assisting the City with project management and various transportation planning and engineering tasks. Traffic Patterns is needed to continue assisting the Engineering Services Department with various transportation projects.

Options

1) Authorize the City Manager to execute the amendment to the agreement with Traffic Patterns, LLC for the additional services in an amount not to exceed $283,372. This would bring the total compensation of Traffic Patterns, LLC pursuant to its Professional Services Agreement with the City to an amount not to exceed $543,372.

Advantages: Assistance is needed to support the tremendous workload in the City's Transportation Services Division.

Disadvantages: None

2) Do not execute the amendment to the agreement with Traffic Patterns, LLC.

Advantages: None

Disadvantages: Staff has too many high-priority items to effectively manage and deliver without support.

Recommendation

The staff recommends Option 1.

TRAFFIC PATTERNS

October 21, 2020

City of Los Altos
Attn: Jim Sandoval
1 N San Antonio Road
Los Altos, CA 94022

Subject: Work Scope for On-Call Traffic Engineering & Transportation Planning Services

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Thank you for contacting Traffic Patterns to provide the City of Los Altos with on-call traffic engineering and transportation planning services. These services include acting as the City's Interim Transportation Services Manager and reporting to the City's Engineering Services Director (Director). In these roles, Traffic Patterns recommends the following services.

Task 1 – Project Management

Traffic Patterns will coordinate with City staff on the development and management of existing transportation projects and programs. Within this task Traffic Patterns will advise on the development of Capital Improvement Program (CIP) projects and other transportation related programs, including project inspection, design development, and design review service.

Task 2 – Traffic Operations Investigations and Improvements

Traffic Patterns will serve as an extension of City staff responding to resident requests for traffic operations improvements. Traffic Patterns will be responsible for responding to email and phone traffic operations complaints and be responsible for responding to residents and investigating complaints. Traffic Patterns will determine the appropriate traffic operations improvements in response to concerns, if any, and then develop work order improvement details for implementation by City forces. Traffic Patterns will be responsible for keeping residents informed regarding the investigation and improvement process.

Task 3 – Complete Streets Commission Liaison

Traffic Patterns will serve as the Complete Streets Commission city staff liaison, this will include developing monthly agenda's, participating in monthly meetings with the commission, and developing and implementing a commission work plan. Any commission agenda items that require the development of staff reports will be the responsibility of Traffic Patterns. Traffic Patterns will also be responsible for participating in monthly coordination meetings with the Commission Chair and Vice Chair to develop monthly agendas.

Task 4 – Traffic Signal Management

Traffic Patterns will be responsible for the operations and management of the City's 8 existing traffic signal facilities, 8 additional traffic signals operated by the County of Santa Clara on behalf of the City of Los Altos. The management of physical traffic signal hardware will be responsibility of the City's on-call electrical contractor, Bear Electrical, but Traffic Patterns will be responsible for identifying traffic signal operations improvements and directing improvements to the County. Traffic signal operations timing improvements will be implemented directly by Traffic Patterns upon receiving written authorization from the City.

Task 5 – Transportation Planning

Traffic Patterns will support the City's Planning Department with the review of Transportation Impact Analysis (TIA) and Transportation Demand Management (TDM) studies, development site plans, and off-site improvement plans, and any other support services requested by the Planning Department through the Director.

Task 6 – Community Engagement

Traffic Patterns will be responsible leading community meetings related to traffic operations and transportation planning matters including the development of presentation materials. Immediate community engagement projects will include the completion of the City's Complete Streets Master Plan. Traffic Patterns will also be required to participate in City Council and other City Commissions and community outreach meetings, as needed, related to transportation projects. Additional services to this task will include the development of community meeting notices and the distribution of community meeting notices.

Task 7 – Additional Services as Needed

Traffic Patterns will provide additional services as needed that are not specifically identified in the above tasks. Traffic Patterns and City will develop future Work Task Orders as needed to document project tasks and budget prior to implementation as needed. Sample Additional Services may include, but not be limited to:

- Development of project specific Plans, Specifications, and Estimate (PS&E) for transportation-related projects
- Procurement and installation of Traffic Signal and Intelligent Transportation Systems (ITS) equipment
- Development of grant applications
- Review and processing of transportation-related procurements and professional proposals, contracts, purchase orders and invoices and make recommendations to the Director for approval
- Printing and Delivery of transportation related documents

The following projects are active within Traffic Patterns' on-going on-call service for the City of Los Altos and included below to documentation purposes:

- El Monte Pathway Project 2020, $36,152
  - $27,500, ActiveWayz Engineering, Civil Design Service
  - $2,500, ActiveWayz Engineering, Bid Support and Construction Support
  - $4,430, Sarro & Assocations, Specifications
  - $1,722, Traffic Patterns 5% Subconsultant Markup

- Cristo Ray Drive Guard Rail Repair Project 2020, $18,500
  - Preliminary Estimate Pending Civil Design and Specifications Estimate

- Smart City Signals, 2020-21 Service Fee, $12,000
  - $125/Month per Traffic Signal on Smart City Signals Platform
  - 8 Locations currently on-line
  - 8 Additional Locations, IoT Panels provided but Not Installed/No Service

Traffic Patterns recommends a project cost of $283,372 to provide a minimum of one year of on-call traffic engineering support and to cover the above special projects that area currently in design. On-call support will include an average of 24 hours per week for the one year period.

TRAFFIC PATTERNS

ATTACHMENT 1

Fee Structure

Table 1
Estimated Fee Schedule
Los Altos On-Call Traffic Engineering

Service / Task	Traffic Patterns Jaime Rodriguez Principal $165	 Manar Zuriakat Intern $45	 Clerical & Administation $75	 Smart City Signals Monthly Service $125	ActiveWayz Engineering Admas Zewdie Pincipal $225	Sarro Associates Suzanne Sarro Principal $125	Project Cost Estimate
On-Call Transportation Service							$216,720
24 Hours/Week x 52 Weeks	$205,920						
Summer 16 Hours/Week (15 Weeks)		$10,800					
Administration (4 Hours/Month)			$3,600				
El Monte Pathway 2020							$36,152
Civic Design (Fixed)					$27,500		
Civil Bid and Construction Support					$2,500		
Specifications Development						$4,430	
Subconsultant Mark-up 5%	$1,722						
Cristo Rey Guard Rail Repair							$18,500
Field Review, Basemap, Plans	$7,000						
Civil Engineer Details and Review					$8,000		
Specifications Development						$3,500	
Smart City Signals Traffic Signals Service							$12,000
8 City Maintained Traffic Signals				$12,000			
						Total:	$283,372

TRAFFIC PATTERNS

ATTACHMENT 1

Fee Structure

Typical Fees - 2020

Work Type	Hourly Rate	Flat Rate
Project Management/Design	$165.00	
Traffic Signal Technician	$140.00	
CAD Operator	$88.00	
Intern	$35.00	
Civil Design Partner - Principal	$225.00	
Civil Design Partner – Project Engineer	$185.00	
Civil Design Partner – Specifications Development	$115.00	
21-Day Traffic Signal Cabinet Burn-In Test/Program		$6,000
Smart City Signals – IoT Traffic Signal Panel		$2,950.00
Smart City Signals – IoT Traffic Signal Panel Install		$300.00
Smart City Signals – Virtual Detection Relay Board		$500.00
Smart City Signals – Monthly Service (Standard)*		$125.00
Smart City Signals – Monthly Service (Expanded)**		$145.00
Smart City Signals – Traffic Counter		$4,950.00
Smart City Signals – Traffic Counter Monthly Service		$250.00
Traffic Control Plans – Standard 3 Week Turnaround		$325.00
Traffic Control Plans – One Week Hour RUSH		$450.00
Traffic Control Plans – Minor Traffic Signal Modifications		$1,500.00
Traffic Control Plans – Long Term Signage & Striping Plans		$1,800.00
Traffic Signal Controller, Type 2070 (Cubic-Trafficware)		$4,250.00
Traffic Signal Cabinet CMU (EDI by Cubic-Trafficware)		$850.00
Traffic Signal Ethernet-over-Copper Switch (EtherWAN)		$1,950.00
Printing – 11 x 17		$3.00
Printing – Full Size 24 x 36		$12.00
Traffic/Civil Engineering Design Projects - Subconsultant Mark-up at 5% of Cost		Request a Quote
Level of Effort Estimate, Typical Month of On-Call Support, 72 Hours per Month - 16 Hours for Complete Streets Commission, Staff Reports and Meetings - 40 Hours for Project Management Oversite - 12 Hours for Traffic Signal Investigations/Customer Service Response - 4 Hours for Agency Coordination		$11,880

* Standard Smart City Signals Service include traffic signal cabinet data only

** Expanded Smart City Signals Service includes dedicated ATMS and Controller comm link and Cloud-Based Advanced Detection for Bicycles, Pedestrians, and Emergency Vehicle/Railroad Preemption

*** Fees include 1-Hour Round Trip for Travel

DISCUSSION ITEM

Agenda Item # 5

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Construction Contract Award: El Monte Avenue Sidewalk Gap Closure Project, TS-01038

Item to be deferred to November 10, 2020

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	CD	SE

From:	Chris Jordan
To:	Jon Biggs; Jolie Houston; Andrea Chelemengos; Guido Persicone
Subject:	FW: agenda item # 6-126 mt hamilton avenue
Date:	Wednesday, October 21, 2020 1:09:27 PM

From: Jon Baer [redacted]
Sent: Wednesday, October 21, 2020 11:24 AM
To: City Council <council@losaltosca.gov>
Cc: Eugene Hyman [redacted]
Subject: agenda item # 6-126 mt hamilton avenue

City Council members-I would encourage you to deny approval of the revised plans that have been presented. While the applicant has made some positive changes, those changes are not sufficient for a large two story home being built in a one-story, consistent character neighborhood. There is simply too much upper mass with verticality in the original design as well as in the revisions which are before you.

The applicant merely moved around second floor volume. To appropriately address the concerns requires a major redo of the plans. Some steps that should be taken include the following:

1. The second floor massing needs to be buried in the first floor roof. Currently the second floor walls are full height with the roof dropped on top. By making this change the building would not fill the daylight plane envelope, which it does with the submitted design. How this is accomplished is up to the applicant, but could also be done, in part by moving the first floor/second floor massing further into the backyard and/or nixing one of the bathrooms on the second floor
2. The two chimneys on either side of the house add to the vertical mass. Given that all three fireplaces use gas, there is no need for any of them.

I would encourage you to deny this application so that the owners can rethink the project. Continued tweaking and reviews by the City Council are not an effective way to get to a solution. It is my hope that staff will be more sensitive to the issue of massive two story homes that are being proposed in consistent character, one-story neighborhoods so that some of these changes get addressed at a staff level before being reviewed by the Design Review Commission in a new application.

Thx-j

From: Chris Jordan
To: Guido Persicone; Jon Biggs; Andrea Chelemengos
Subject: FW: 126 Mt Hamilton Ave
Date: Friday, October 23, 2020 1:06:24 PM

From: Abhambly [redacted]>
Sent: Friday, October 23, 2020 11:33 AM
To: City Council <council@losaltosca.gov>
Subject: 126 Mt Hamilton Ave

Dear Council Members,

I think the owners did address your concern of simplifying the roof line. However, the mass is still there. It is too massive for our consistent character neighborhood of one story houses. The right chimney seems to be more prominent than before!

Thank you for your thorough consideration of the new plans.

The neighbor next door at 100 Mt Hamilton Ave,
Anne Hambly

PUBLIC HEARING

Agenda Item # 7

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Building Electrification and Electric Vehicle Infrastructure Reach Codes – Proposed Reach Codes for 2019 Energy Code

Prepared by: Environmental Commission and Staff
Reviewed by: Jon Biggs, Community Development Director
Approved by: Chris Jordan, City Manager

Attachment(s):
1. Ordinance No. 2020-470A
2. Ordinance No. 2020-470B
3. Ordinance No. 2020-470C
4. Ordinance No. 2020-471

Initiated by:
Environmental Commission

Previous Council Consideration:
November 19, 2019; September 22, 2020

Fiscal Impact:
None

Environmental Review:
The City Council hereby finds and determines that this Ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines, § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. Adoption of the proposed Ordinance would not be an activity with potential to cause significant adverse effect on the environment because the changes made to the California Energy Code are to provide more protection to the environment, and therefore is exempt from CEQA. It is also exempt from CEQA pursuant to CEQA Guidelines, § 15308 which exempts actions taken by regulatory agencies for the enhancement and protection of the environment. As such, the Ordinance is categorically exempt from CEQA.

Policy Question(s) for Council Consideration:

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	JH	SE

Subject: Building Electrification and Electric Vehicle Infrastructure Reach Codes – Proposed Reach Codes for 2019 Energy Code and the 2019 Green Building Standards Code

- Does the Council wish to adopt Building Electrification and Electric Vehicle Infrastructure Codes containing requirements that limits power sources to principally electric appliances, fixtures, and equipment?

Summary:
Every three years, the State of California adopts new building standards that are organized in Title 24 of the California Code of Regulations, referred to as the California Building Standards Code. The City has adopted the 2019 building codes, which became effective statewide on January 1, 2020. Cities and counties can adopt amendments to building codes that have requirements that exceed minimum building code requirements. Reach codes provide requirements that exceed the standards for the energy and green building standards codes and require the installation of electric vehicle infrastructure in new construction.

Recommendation:
The Environmental Commission recommends the City Council adopt building electrification and electric vehicle reach codes, which amend the 2019 California Building Standards Code that was adopted, and became effective on January 1, 2020; to help reduce carbon emissions associated with new construction, reduce costs in new construction, improve indoor air quality and safety of our building stock, support affordable housing, and increase adoption of electric vehicles.

Purpose
The ordinances will put into effect requirements that mandate newly constructed buildings be all-electric with exceptions, and the installation of electric vehicle charging infrastructure for new construction.

Background
On November 19, 2019, the Environmental Commission presented the City Council with a Mixed-Fuel Reach Code Ordinance. During the first reading of the Ordinance, Council directed the Environmental Commission to pursue an All-Electric Reach Code Ordinance and to conduct community outreach.

Discussion/Analysis
On September 22, 2020, by motion Council directed staff to modify the Building and Electrification Reach Code ordinance building type/use and include the following exceptions:

1. All newly constructed Residential Single-Family Buildings, Multi-family Buildings having two to nine residential units, and Detached Accessory Dwelling Unit Buildings, will allow for the following exceptions:

Exception 1: Residential Single-Family Dwellings, Detached ADUs (Accessory Dwelling Units), and Multifamily Dwellings with two to nine units may install non-electric (natural gas-fueled) cooking and fireplace appliances if the applicant complies with the prewiring provisions, Subsection 12.22.020 B.3.

2. All newly constructed Multi-Family Residential Developments having ten (10) or more units shall meet the requirements of Subsections B, C, D or E, as applicable and shall be an all-electric building as defined in Section 100.1(b).

3. All newly constructed Non-Residential Buildings, Scientific Laboratory Buildings, and Public Buildings will allow for the following exceptions:

   Exception 2: Non-residential Buildings containing for-profit restaurant open to the public may install gas-fueled cooking appliances. The applicant shall comply with the pre-wiring provision of Subsection 12.22.020 B. 3.

   Exception 3: Non-residential buildings, Scientific Laboratory Buildings and Public Buildings may apply to the Building Division of the Los Altos Community Development Department for an exception to install a non-electric fueled appliance or piece of equipment. The Building Division of the Los Altos Community Development Department shall grant an exception if they find the following conditions are met:

   i. The applicant shows that there is a public or business-related need that cannot be reasonably met with an electric appliance or piece of equipment.
   ii. The applicant complies with the pre-wiring provisions to the non-electric appliance or piece of equipment noted at Subsection 12.22.020 B. 3.

The ordinances have been drafted in a way that requires they be adopted in a specific sequence, given the varying votes on the types of uses subject to the new code sections – the Ordinance No. 2020-470A should be considered first, Ordinance No. 2020-470B should be considered next and Ordinance 2020-470C considered last. To assist in tracking the changes presented by each ordinance, staff has underlined language being added.

Options

Subject: Building Electrification and Electric Vehicle Infrastructure Reach Codes – Proposed Reach Codes for 2019 Energy Code and the 2019 Green Building Standards Code

1) Adopt Ordinance No. 2020-470A, Ordinance No. 2020-470B, and Ordinance No. 2020-470C, in the recommended sequence, amending chapter 12.22 Energy Code of Title 12 of the Los Altos Municipal code relating to amendments to the 2019 California Energy Code for All-Electric Buildings and adopt Ordinance No. 2020-471 amending chapter 12.26 Green Building Standards Code for Electric Vehicle Infrastructure.

Advantages: Reduce carbon emissions associated with new construction, improve indoor air quality and building safety, support affordable housing, and increase adoption of electric vehicles.

Disadvantages: Fail to follow PCE and SVCE member agencies that have already adopted reach codes to reduce carbon emissions associated with new construction, Fail to adopt a policy that advances the City's sustainability and GHG emission reductions in line with Council Strategic Goals and Objectives 7. Do not take advantage of an opportunity to improve new building indoor air quality and safety, support affordable housing, and increase adoption of electric vehicles.

2) Do not adopt the Ordinance(s) and provide staff direction on changes to the Ordinance(s).

Advantages: Modifications can be made to the Ordinance(s) as necessary before being reintroduced

Disadvantages: Implementation will be delayed and allow for continued environmental harm and action to further environmental goals will be delayed

Recommendation
The staff recommends Option 1.

ORDINANCE NO. 2020-470A
AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS AMENDING CHAPTER 12.22 ENERGY CODE OF TITLE 12 OF THE LOS ALTOS MUNICIPAL CODE RELATING TO AMENDMENTS TO THE 2019 CALIFORNIA ENERGY CODE FOR ALL-ELECTRIC SINGLE-FAMILY BUILDINGS, MULTI-FAMILY BUILDINGS HAVING FROM TWO TO NINE RESIDENTIAL UNITS, AND DETACHED ACCESSORY DWELLING UNIT BUILDINGS

WHEREAS, the California Building Standards Commission adopted and published an updated Title 24 of the California Code of Regulations, known as the 2019 California Building Standards Code, that became effective statewide on January 1, 2020; and

WHEREAS, California Health and Safety Code Sections 17958.5, 17958.7 and 18941.5 authorize cities to adopt the California Building Standards Code with modifications determined to be reasonably necessary because of local climatic, geological, or topographical conditions; and

WHEREAS, the City of Los Altos has adopted the 2019 California Building Standards Code with local amendments; and

WHEREAS, the City has adopted the 2019 California Energy Code in the 2019 California Building Standards Code, Part 6 of Title 24 of the California Code of Regulations, which implements minimum energy efficiency standards in buildings through mandatory requirements, prescriptive standards, and performances standards; and

WHEREAS, Public Resources Code Section 25402.l(h)(2) and Section 10-106 Locally Adopted Energy Standards of the California Administrative Code, Title 24 of the California Code of Regulations, Part I, establish a process which allows local adoption of energy standards that are more stringent than the statewide standards, provided that such local standards are cost effective and the California Energy Commission finds that the standards will require buildings to be designed to consume no more energy than permitted by the California Energy Code; and

WHEREAS, the City Council wishes to amend portions of the California Energy Code and affirms that such local modifications are cost effective and will result in designs that consume no more energy than that permitted under the 2019 California Energy Code; and

WHEREAS, the City's Climate Action Plan sets forth the goal to support initiatives that promote environmental sustainability and reduce the City's greenhouse gas emissions.

NOW THEREFORE, the City Council of the City of Los Altos does hereby ordain as follows:

SECTION 1. AMENDMENT OF CODE. Chapter 12.22 of Title 12 of the Los Altos Municipal Code is hereby amended in its entirety to read as follows:

Chapter 12.22 ENERGY CODE

Section 12.22.010 Adoption of the California Energy Code.

There is hereby adopted by reference as if fully set forth herein, the 2019 California Energy Code, contained in the California Code of Regulations, Title 24, Part 6, published by the International Code Council, and each and all of its regulations and provisions. One copy is on file for use and examination by the public in the office of the Building Official.

Section 12.22.020 Amendments for All-Electric Buildings.

A. Amend Section 100.1(b) of the Energy Code by adding the following definitions to read as follows:

ALL-ELECTRIC BUILDING is a building that has no natural gas or propane plumbing installed within the building.

NEWLY CONSTRUCTED BUILDING (Applicable to Chapter 12.22 Energy Code Section 12.22.020 Amendments) is a building that has never been used or occupied for any purpose and supported by 1) a new structural foundation, 2) an existing, structural foundation where a building has been demolished and removed to floor or below, or 3) a combination of 1) and 2).

PUBLIC BUILDING is a building used by the public for any purpose, such as assembly, education, entertainment, or worship.

SCIENTIFIC LABORATORY BUILDING is a building or area where research, experiments, and measurement in medical, life, and physical sciences are performed and/or stored requiring examination of fine details. The building may include workbenches, countertops, scientific instruments, and supporting offices.

Subchapter 1 Section 100.0(e)2. A. is deleted and replaced to read as follows, based on express finding of necessity set forth of this Ordinance.

B. Amend Section 100.0(e)2. A. of the Energy Code to read as follows:

2. Newly constructed buildings.

A. Sections 110.0 through 110.12 apply to all newly constructed buildings within the scope of Section 100.0(a). In addition, newly constructed buildings shall meet the requirements of Subsections B, C, D or E, as applicable and shall be an all-electric building as defined in Section 100.1(b).

Exception 1: Residential Single-Family Dwellings, Detached ADUs (Accessory Dwelling Units), Multifamily Dwellings with two to nine units may install non-electric (natural gas-fueled) cooking and fireplace appliances if the applicant complies with the prewiring provisions, Subsection 12.22.020 B.3.

3. Wiring to accommodate future electric appliances or equipment.

(a) If a non-electric appliance or piece of equipment is allowed to be installed, the appliance or equipment location must also be electrically pre-wired for future electric appliance or equipment installation, including:

i. A dedicated circuit, phased appropriately, with a minimum amperage requirement for a comparable electric appliance with an electrical receptacle or junction box that is connected to the electric panel with conductors of adequate capacity, extending to within 3 feet of the appliance and accessible with no obstructions. Appropriately sized conduit may be installed in lieu of conductors; and

ii. Both ends of the unused conductor or conduit shall be labeled with the words "For Future Electric appliance or equipment" and be electrically isolated; and

iii. A reserved circuit breaker space shall be installed in the electrical panel adjacent to the circuit breaker for the branch circuit and labeled for each circuit, an example is as follows (i.e. "For Future Electric Range;"); and,

iv. All electrical components, including conductors, receptacles, junction boxes, or blank covers, related to this section shall be installed in accordance with the California Electrical Code.

SECTION 2.

The following findings support that the above amendments and modifications are reasonably necessary because of local climatic, geological or topographical conditions:

The City of Los Altos is located in Climate Zone 4 as established in the 2019 California Energy Code. Climate Zone 4 includes Santa Clara County, San Benito County, portions of Monterey County and San Luis Obispo. The City experiences an average of 19 inches of precipitation per year. In Los Altos, January is the rainiest month of the year while July is the driest month of the year. Temperatures average about 80 degrees Fahrenheit in the summer and about 40 degrees Fahrenheit in the winter. These climatic conditions along with the effects of climate change caused by Green House Gas (GHG) emissions generated from burning natural gas to heat buildings and emissions from Vehicle Miles Traveled results in an overall increase in global average temperature. Higher global temperatures are contributing to rising sea levels, record heat waves, droughts, wildfires and floods.

The above local amendments to the 2019 California Energy Code are necessary to combat the ever-increasing harmful effects of global climate change. Implementation of the proposed code amendments will achieve decarbonization and provide an accelerated path to reduce GHG emissions. The proposed Ordinance containing these amendments would ensure that new buildings use cleaner sources of energy which helps meet the goal of cutting carbon emissions in half by 2030.

All-electric building design benefits the health, welfare, and resiliency of Los Altos and its residents.

SECTION 3. CONSTITUTIONALITY.

If any section, subsection, sentence, clause or phrase of this code is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

SECTION 4. CEQA.

The City Council hereby finds and determines that this Ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines, § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. Adoption of the proposed Ordinance would not be an activity with potential to cause significant adverse effect on the environment because the changes made to the California Energy Code within are enacted to provide more protection to the environment, and therefore is exempt from CEQA. It is also exempt from CEQA pursuant to CEQA Guidelines, § 15308 which exempts actions taken by regulatory agencies for the enhancement and protection of the environment. As such, the Ordinance is categorically exempt from CEQA.

SECTION 5. PUBLICATION.

This Ordinance shall be published as provided in Government Code section 36933.

SECTION 6. EFFECTIVE DATE.

This Ordinance shall be effective upon the commencement of the thirty-first (31st) day following the adoption date. The City Council's findings of cost-effectiveness and energy savings will be filed with the California Energy Commission pursuant to Title 24 Chapter 10-106 before this ordinance takes effect.

The foregoing Ordinance was duly and properly introduced at a regular meeting of the City Council of the City of Los Altos held on ________, 2020 and was thereafter, at a regular meeting held on ____________, 2020 passed and adopted by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

____
Janis C. Pepper, Mayor

ATTEST

____
Andrea Chelemengos MMC, City Clerk

ORDINANCE NO. 2020-470B

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS AMENDING CHAPTER 12.22 ENERGY CODE OF TITLE 12 OF THE LOS ALTOS MUNICIPAL CODE RELATING TO AMENDMENTS TO THE 2019 CALIFORNIA ENERGY CODE FOR ALL-ELECTRIC MULTI-FAMILY RESIDENTIAL DEVELOPMENTS HAVING TEN (10) OR MORE UNITS

WHEREAS, the California Building Standards Commission adopted and published an updated Title 24 of the California Code of Regulations, known as the 2019 California Building Standards Code, that became effective statewide on January 1, 2020; and

WHEREAS, California Health and Safety Code Sections 17958.5, 17958.7 and 18941.5 authorize cities to adopt the California Building Standards Code with modifications determined to be reasonably necessary because of local climatic, geological, or topographical conditions; and

WHEREAS, the City of Los Altos has adopted the 2019 California Building Standards Code with local amendments; and

WHEREAS, the City has adopted the 2019 California Energy Code in the 2019 California Building Standards Code, Part 6 of Title 24 of the California Code of Regulations, which implements minimum energy efficiency standards in buildings through mandatory requirements, prescriptive standards, and performances standards; and

WHEREAS, Public Resources Code Section 25402.l(h)(2) and Section 10-106 Locally Adopted Energy Standards of the California Administrative Code, Title 24 of the California Code of Regulations, Part I, establish a process which allows local adoption of energy standards that are more stringent than the statewide standards, provided that such local standards are cost effective and the California Energy Commission finds that the standards will require buildings to be designed to consume no more energy than permitted by the California Energy Code; and

WHEREAS, the City Council wishes to amend portions of the California Energy Code and affirms that such local modifications are cost effective and will result in designs that consume no more energy than that permitted under the 2019 California Energy Code; and

WHEREAS, the City's Climate Action Plan sets forth the goal to support initiatives that promote environmental sustainability and reduce the City's greenhouse gas emissions.

NOW THEREFORE, the City Council of the City of Los Altos does hereby ordain as follows:

SECTION 1. AMENDMENT OF CODE. Chapter 12.22 of Title 12 of the Los Altos Municipal Code is hereby amended in its entirety to read as follows:

Chapter 12.22 ENERGY CODE

Section 12.22.010 Adoption of the California Energy Code.

There is hereby adopted by reference as if fully set forth herein, the 2019 California Energy Code, contained in the California Code of Regulations, Title 24, Part 6, published by the International Code Council, and each and all of its regulations and provisions. One copy is on file for use and examination by the public in the office of the Building Official.

Section 12.22.020 Amendments for All-Electric Buildings.

A. Amend Section 100.0(e)2. A. of the Energy Code to include the underlined language as follows:

2. Newly constructed buildings.

A. Sections 110.0 through 110.12 apply to all newly constructed buildings within the scope of Section 100.0(a). In addition, newly constructed buildings shall meet the requirements of Subsections B, C, D or E, as applicable and shall be an all-electric building as defined in Section 100.1(b).

Exception 1: Residential Single-Family Dwellings, Detached ADUs (Accessory Dwelling Units), Multifamily Dwellings with two to nine units may install non-electric (natural gas-fueled) cooking and fireplace appliances if the applicant complies with the prewiring provisions, Subsection 12.22.020 B.3.

SECTION 2.

The following findings support that the above amendments and modifications are reasonably necessary because of local climatic, geological or topographical conditions:

The City of Los Altos is located in Climate Zone 4 as established in the 2019 California Energy Code. Climate Zone 4 includes Santa Clara County, San Benito County, portions of Monterey County and San Luis Obispo. The City experiences an average of 19 inches of precipitation per year. In Los Altos, January is the rainiest month of the year while July is the driest month of the year. Temperatures average about 80 degrees Fahrenheit in the summer and about 40 degrees Fahrenheit in the winter. These climatic conditions along with the effects of climate change caused by Green House Gas (GHG) emissions generated from burning natural gas to heat buildings and emissions from Vehicle Miles Traveled results in an overall increase in global average temperature. Higher global temperatures are contributing to rising sea levels, record heat waves, droughts, wildfires and floods.

The above local amendments to the 2019 California Energy Code are necessary to combat the ever-increasing harmful effects of global climate change. Implementation of the proposed code amendments will achieve decarbonization and provide an accelerated path to reduce GHG emissions. The proposed Ordinance containing these amendments would ensure that new buildings use cleaner sources of energy which helps meet the goal of cutting carbon emissions in half by 2030.

All-electric building design benefits the health, welfare, and resiliency of Los Altos and its residents.

SECTION 3. CONSTITUTIONALITY.

If any section, subsection, sentence, clause or phrase of this code is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

SECTION 4. CEQA.

The City Council hereby finds and determines that this Ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines, § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. Adoption of the proposed Ordinance would not be an activity with potential to cause significant adverse effect on the environment because the changes made to the California Energy Code within are enacted to provide more protection to the environment, and therefore is exempt from CEQA. It is also exempt from CEQA pursuant to CEQA Guidelines, § 15308 which exempts actions taken by regulatory agencies for the enhancement and protection of the environment. As such, the Ordinance is categorically exempt from CEQA.

SECTION 5. PUBLICATION.

This Ordinance shall be published as provided in Government Code section 36933.

SECTION 6. EFFECTIVE DATE.

This Ordinance shall be effective upon the commencement of the thirty-first (31st) day following the adoption date. The City Council's findings of cost-effectiveness and energy savings will be filed with the California Energy Commission pursuant to Title 24 Chapter 10-106 before this ordinance takes effect.

The foregoing Ordinance was duly and properly introduced at a regular meeting of the City Council of the City of Los Altos held on ________, 2020 and was thereafter, at a regular meeting held on _____________, 2020 passed and adopted by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

____
Janis C. Pepper, Mayor

ATTEST

____
Andrea Chelemengos MMC, City Clerk

ORDINANCE NO. 2020-470C

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS AMENDING CHAPTER 12.22 ENERGY CODE OF TITLE 12 OF THE LOS ALTOS MUNICIPAL CODE RELATING TO AMENDMENTS TO THE 2019 CALIFORNIA ENERGY CODE FOR ALL-ELECTRIC NON-RESIDENTIAL BUILDINGS, SCIENTIFIC LABORATORY BUILDINGS, AND PUBLIC BUILDINGS

WHEREAS, the California Building Standards Commission adopted and published an updated Title 24 of the California Code of Regulations, known as the 2019 California Building Standards Code, that became effective statewide on January 1, 2020; and

WHEREAS, California Health and Safety Code Sections 17958.5, 17958.7 and 18941.5 authorize cities to adopt the California Building Standards Code with modifications determined to be reasonably necessary because of local climatic, geological, or topographical conditions; and

WHEREAS, the City of Los Altos has adopted the 2019 California Building Standards Code with local amendments; and

WHEREAS, the City has adopted the 2019 California Energy Code in the 2019 California Building Standards Code, Part 6 of Title 24 of the California Code of Regulations, which implements minimum energy efficiency standards in buildings through mandatory requirements, prescriptive standards, and performances standards; and

WHEREAS, Public Resources Code Section 25402.l(h)(2) and Section 10-106 Locally Adopted Energy Standards of the California Administrative Code, Title 24 of the California Code of Regulations, Part I, establish a process which allows local adoption of energy standards that are more stringent than the statewide standards, provided that such local standards are cost effective and the California Energy Commission finds that the standards will require buildings to be designed to consume no more energy than permitted by the California Energy Code; and

WHEREAS, the City Council wishes to amend portions of the California Energy Code and affirms that such local modifications are cost effective and will result in designs that consume no more energy than that permitted under the 2019 California Energy Code; and

WHEREAS, the City's Climate Action Plan sets forth the goal to support initiatives that promote environmental sustainability and reduce the City's greenhouse gas emissions.

NOW THEREFORE, the City Council of the City of Los Altos does hereby ordain as follows:

SECTION 1. AMENDMENT OF CODE. Chapter 12.22 of Title 12 of the Los Altos Municipal Code is hereby amended in its entirety to read as follows:

Chapter 12.22 ENERGY CODE

Section 12.22.010 Adoption of the California Energy Code.

There is hereby adopted by reference as if fully set forth herein, the 2019 California Energy Code, contained in the California Code of Regulations, Title 24, Part 6, published by the International Code Council, and each and all of its regulations and provisions. One copy is on file for use and examination by the public in the office of the Building Official.

A. Amend Section 100.0(e) 2. A. of the Energy Code is amended to include the underlined language as follows:

2. Newly constructed buildings.

A. Sections 110.0 through 110.12 apply to all newly constructed buildings within the scope of Section 100.0(a). In addition, newly constructed buildings shall meet the requirements of Subsections B, C, D or E, as applicable and shall be an all-electric building as defined in Section 100.1(b).

Exception 1: Residential Single-Family Dwellings, Detached ADUs (Accessory Dwelling Units), Multifamily Dwellings with two to nine units may install non-electric (natural gas-fueled) cooking and fireplace appliances if the applicant complies with the prewiring provisions, Subsection 12.22.020 B.3.

<u>Exception 2: Non-residential Buildings containing for-profit restaurant open to the public may install gas-fueled cooking appliances. The applicant shall comply with the pre-wiring provision of Subsection 12.22.020 B. 3.</u>

<u>Exception 3: Non-residential buildings, Scientific Laboratory Buildings and Public Buildings may apply to the Building Division of the Los Altos Community Development Department for an exception to install a non-electric appliance or piece of equipment. The Building Division of the Los Altos Community Development Department shall grant an exception if they find the following conditions are met:</u>

<u>i. The applicant shows that there is a public or business-related need that cannot be reasonably met with an electric fueled appliance or piece of equipment.</u>

<u>ii. The applicant complies with the pre-wiring provisions to the non-electric appliance or piece of equipment noted at Subsection 12.22.020 B. 3.</u>

The decision of the Building Division of the Los Altos Community Development Department shall be final unless the applicant appeals the decision to the City Manager or his or her designee within 15 days of the date of the decision. The City Manager's or his or her designee's decision on the appeal shall be final.

SECTION 2.

The following findings support that the above amendments and modifications are reasonably necessary because of local climatic, geological or topographical conditions:

The City of Los Altos is located in Climate Zone 4 as established in the 2019 California Energy Code. Climate Zone 4 includes Santa Clara County, San Benito County, portions of Monterey County and San Luis Obispo. The City experiences an average of 19 inches of precipitation per year. In Los Altos, January is the rainiest month of the year while July is the driest month of the year. Temperatures average about 80 degrees Fahrenheit in the summer and about 40 degrees Fahrenheit in the winter. These climatic conditions along with the effects of climate change caused by Green House Gas (GHG) emissions generated from burning natural gas to heat buildings and emissions from Vehicle Miles Traveled results in an overall increase in global average temperature. Higher global temperatures are contributing to rising sea levels, record heat waves, droughts, wildfires and floods.

The above local amendments to the 2019 California Energy Code are necessary to combat the ever-increasing harmful effects of global climate change. Implementation of the proposed code amendments will achieve decarbonization and provide an accelerated path to reduce GHG emissions. The proposed Ordinance containing these amendments would ensure that new buildings use cleaner sources of energy which helps meet the goal of cutting carbon emissions in half by 2030.

All-electric building design benefits the health, welfare, and resiliency of Los Altos and its residents.

SECTION 3. CONSTITUTIONALITY.

If any section, subsection, sentence, clause or phrase of this code is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

SECTION 4. CEQA.

The City Council hereby finds and determines that this Ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines, § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. Adoption of the proposed Ordinance would not be an activity with potential to cause significant adverse effect on the environment because the changes made to the California Energy Code within are enacted to provide more protection to the environment, and therefore is exempt from CEQA. It is also exempt from CEQA pursuant to CEQA Guidelines, § 15308 which exempts actions taken by regulatory agencies for the enhancement and protection of the environment. As such, the Ordinance is categorically exempt from CEQA.

SECTION 5. PUBLICATION.

This Ordinance shall be published as provided in Government Code section 36933.

SECTION 6. EFFECTIVE DATE.

This Ordinance shall be effective upon the commencement of the thirty-first (31st) day following the adoption date. The City Council's findings of cost-effectiveness and energy savings will be filed with the California Energy Commission pursuant to Title 24 Chapter 10-106 before this ordinance takes effect.

The foregoing Ordinance was duly and properly introduced at a regular meeting of the City Council of the City of Los Altos held on ________, 2020 and was thereafter, at a regular meeting held on _____________, 2020 passed and adopted by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

____
Janis C. Pepper, Mayor

ATTEST

____
Andrea Chelemengos MMC, City Clerk

ORDINANCE NO. 2020-471
AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS AMENDING CHAPTER 12.26 GREEN BUILDING STANDARDS CODE OF TITLE 12 OF THE LOS ALTOS MUNICIPAL CODE RELATING TO AMENDMENTS TO THE 2019 CALIFORNIA GREEN BUILDING STANDARDS CODE FOR ELECTRIC VEHICLE (EV) INFRASTRUCTURE

WHEREAS, the City of Los Altos has seen significant sales of both electric vehicles (EV) and plug-in hybrid electric vehicles ("PHEV"); and

WHEREAS, the interest in EVs has grown alongside greater EV model availability, increased vehicle range, and expanded EV charging infrastructure in the region; and

WHEREAS, EV charging infrastructure available at locations they frequent, including one-and two-family dwellings, multi-family residences, and commercial properties is important for continued adoption of EVs; and

WHEREAS, the installation of the electric vehicle supply equipment (EVSE) is made cost effective when the infrastructure is installed during the initial construction phase as opposed to retrofitting existing buildings to accommodate the new electrical equipment; and

WHEREAS, the City of Los Altos supports this nascent industry for plug-in electric vehicles and its efforts in constructing EV charging infrastructure as this further supports the City's sustainability goals; and

WHEREAS, the California Building Standards Commission adopted and published an updated Title 24 of the California Code of Regulations, known as the 2019 California Building Standards Code, that became effective statewide on January 1, 2020; and

WHEREAS, California Health and Safety Code Sections 17958.5, 17958.7 and 18941.5 authorize cities to adopt the California Building Standards Code with modifications determined to be reasonably necessary because of local climatic, geological or topographical conditions; and

WHEREAS, the City of Los Altos has adopted the 2019 California Building Standards Code with local amendments; and

WHEREAS, the City has adopted the 2019 California Green Building Standards Code in the 2019 California Building Standards Code, Title 24, Part 11, which enhances the design and construction of buildings through the use of building concepts having a reduced negative impact or positive environmental impact and encouraging sustainable construction practices; and

WHEREAS, the City Council wishes to amend portions of the California Green Building Standards Code and affirms the modifications are determined to be reasonably necessary because of local climatic, geological or topographical conditions, ensure that new buildings can charge a greater number of electric vehicles beyond state code requirements and reduce greenhouse gas emissions.

NOW THEREFORE, the City Council of the City of Los Altos does hereby ordain as follows:

SECTION 1. AMENDMENT OF CODE. Chapter 12.26 of Title 12 of the Los Altos Municipal Code is hereby amended in its entirety to read as follows:

Chapter 12.26 CALIFORNIA GREEN BUILDING STANDARDS CODE

Section 12.26.010 Adoption of the California Green Building Standards Code
Section 12.26.020 Amendments, Additions or Deletions
Section 12.26.030 Definitions

Section 12.26.010 Adoption of the California Green Building Standards Code

There is hereby adopted by reference as if fully set forth herein, the 2019 California Green Building Standards Code, contained in the California Code of Regulations, Title 24, Part 11, published by the International Code Council, and each and all of its regulations and provisions. One copy is on file for use and examination by the public in the office of the Building Official.

Section 12.26.020 Amendments, Additions or Deletions

The 2019 California Green Building Standards Code referred to in Section 12.26.010 is adopted, together with Chapters 1 Administration, 4 Residential Mandatory Measures, and 5 Nonresidential Mandatory Measures, of the 2019 California Green Building Standards Code, with the following amendments as follows:

Chapter 1 Section 102.4 Scope and Mandatory Compliance is hereby added to read as follows.

Section 102.4 Scope and Mandatory Compliance

A. This code contains both mandatory and voluntary green building measures. Mandatory and voluntary measures are identified in the appropriate chapters contained in this code. Compliance measures and methods shall be by one of the following measures approved by the Building Official.

   The means by which compliance measures are achieved shall be mandatory measures with appendix sections voluntarily applied, building division mandatory check list, whole house Build it Green GreenPoint check list, LEED, other recognized point systems, Title 24 Part 6 Energy Efficiency Standards, or equivalent approved methods. Green Building Compliance measures in addition to checklists shall be incorporated into the project drawings approved by the Building

Official prior to building permit submittal.

Prior to issuance of a building permit, the owner or responsible Registered Design Professional acting as the owner's agent shall employ and/or retain a Qualified Green Building Professional to the satisfaction of the Building Official, and prior to final inspection shall submit verification that the project is in compliance with this ordinance.

Chapter 4 Section 4.106.4 Electric vehicle (EV) charging for new construction thru 4.106.4.2.5 are deleted and replaced to read as follows, based upon express findings set forth in this Ordinance

Section 4.106.4, 4.106.4.1 and 4.106.2 are amended to read as follows:

4.106.4 Electric vehicle (EV) charging for new construction.

New construction shall comply with Sections 4.106.4.1, 4.106.4.2, or 4.106.4.3 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. Where there is no commercial power supply

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

3. Spaces accessible only by automated mechanical car parking systems are excepted from providing EV charging infrastructure.

4.106.4.1 New one- and two-family dwellings and townhouses with attached or detached private garages.

For each dwelling unit, install a Level 2 EV Ready Space in the garage. If multiple (two or more) garage parking spaces are provided for a dwelling unit, install two Level 2 EV Ready Spaces.

4.106.4.1.1 Identification.

The raceway termination location shall be permanently and visibly marked as "Level 2 EV-Ready".

4.106.4.2 New multifamily dwellings.

The following requirements apply to all new multifamily dwellings:

1. For multifamily buildings with less than or equal to 20 dwelling units, install one Level 2 EV Ready Space for each dwelling unit.

2. When more than 20 multifamily dwelling units are constructed on a building site

a. 25% of the dwelling units with parking space(s) shall be provided with at least one Level 2 EV Ready Space. Calculations for the required minimum number of Level 2 EV Ready spaces shall be rounded up to the nearest whole number and not less than 21 spaces.
b. In addition, each remaining dwelling unit with parking space(s) shall be provided with at least a Level 1 EV Ready Space.

Exception: For all multifamily Affordable housing, 10% of dwelling units with parking space(s) shall be provided with at least one Level 2 EV Ready Space. Calculations for the required minimum number of Level 2 EV Ready spaces shall be rounded up to the nearest whole number. The remaining dwelling units with parking space(s) shall each be provided with at least a Level 1 EV Ready Space.

Notes:

1. ALMS may be installed to decrease electrical service and transformer costs associated with EV Charging Equipment subject to review of the authority having jurisdiction.
2. Installation of Level 2 EV Ready Spaces above the minimum number required level may offset the minimum number Level 1 EV Ready Spaces required on a 1:1 basis.
3. The requirements apply to multifamily buildings with parking spaces including: a) assigned or leased to individual dwelling units, and b) unassigned residential parking.
4. Local jurisdictions may consider allowing exceptions through their local process, on a case by case basis, if a building permit applicant provides documentation detailing that the increased cost of utility service or on-site transformer capacity would exceed an average of $4,500 among parking spaces with Level 2 EV Ready Spaces and Level 1 EV Ready Spaces. If costs are found to exceed this level, the applicant shall provide EV infrastructure up to a level that would not exceed this cost for utility service or on-site transformer capacity.
5. In order to adhere to accessibility requirements in accordance with California Building Code Chapters 11A and/or 11B, it is recommended that all accessible parking spaces for covered newly constructed multifamily dwellings are provided with Level 1 or Level 2 EV Ready Spaces.

4.106.4.2.1.1 Electric vehicle charging stations (EVCS).

When EV chargers are installed, EV spaces required by Section 4.106.4.2.2, Item 3, shall comply with at least one of the following options:

1. The EV space shall be located adjacent to an accessible parking space meeting the requirements of the California Building Code, Chapter 11A, to allow use of the EV charger from the accessible parking space.
2. The EV space shall be located on an accessible route, as defined in the California Building Code, Chapter 2, to the building.

Exception: Electric vehicle charging stations designed and constructed in compliance with the California Building Code, Chapter 11B, are not required to comply with Section 4.106.4.2.1.1 and Section 4.106.4.2.2, Item 3.

Note: Electric vehicle charging stations serving public housing are required to comply with the California Building Code, Chapter 11 B.

Section 4.106.4.2.2 Electric vehicle charging space (EV space) dimensions.

Refer to local authority having jurisdiction for parking dimension requirements.

4.106.4.2.3 Deleted

4.106.4.2.4 Deleted

4.106.4.2.5 Deleted

Chapter 5 Section 5.106.5.3 Electric vehicle (EV) charging thru 5.106.5.3.5 are deleted and replaced to read as follows, based upon express findings set forth in this Ordinance

Section 5.106.5.3 thru 5.106.5.3.5 are amended to read as follows:

5.106.5.3 Electric vehicle (EV) charging.

[N] New construction shall comply with Section 5.106.5.3.1 or Section 5.106.5.3.2 to facilitate future installation and use of EV.

Exceptions:

1. Where there is no commercial power supply.
2. Spaces accessible only by automated mechanical car parking systems are excepted from providing EV charging infrastructure.

5.106.5.3.1 Office buildings.

In nonresidential new construction buildings designated primarily for office use with parking:

1. When 10 or more parking spaces are constructed, 10% of the available parking spaces on site shall be equipped with Level 2 EVCS;
2. An additional 10% shall be provided with at least Level 1 EV Ready Spaces; and
3. An additional 30% shall be at least Level 2 EV Capable.

Calculations for the required minimum number of spaces equipped with Level 2 EVCS, Level 1 EV Ready spaces and EV Capable spaces shall all be rounded up to the nearest whole number.

Construction plans and specifications shall demonstrate that all raceways shall be a minimum of 1" and sufficient for installation of EVCS at all required Level 1 EV Ready and EV Capable spaces; Electrical calculations shall substantiate the design of the electrical system to include the rating of equipment and any on-site distribution transformers, and have sufficient capacity to simultaneously charge EVs at all required EV spaces including Level 1 EV Ready and EV Capable spaces; and service panel or subpanel(s) shall have sufficient capacity to accommodate the required number of dedicated branch circuit(s) for the future installation of the EVSE.

Notes:

1. ALMS may be installed to increase the number of EV chargers or the amperage or voltage beyond the minimum requirements in this code. The option does not allow for installing less electrical panel capacity than would be required without ALMS.

5.106.5.3.2 Other nonresidential buildings.

In nonresidential new construction buildings that are not designated primarily for office use, such as retail or institutional uses:

1. When 10 or more parking spaces are constructed, 6% of the available parking spaces on site shall be equipped with Level 2 EVCS;
2. An additional 5% shall be at least Level 1 EV Ready.
   Calculations for the required minimum number of spaces equipped with Level 2 EVCS and Level 1 EV Ready spaces shall be rounded up to the nearest whole number

Exception: Installation of each Direct Current Fast Charger with the capacity to provide at least 80 kW output may substitute for six Level 2 EVCS and five EV Ready spaces after a minimum of six Level 2 EVCS and five Level 1 EV Ready spaces are installed.

5.106.5.3.3 Clean Air Vehicle Parking Designation.

EVCS qualify as designated parking as described in Section 5.106.5.2 Designated parking for clean air vehicles.

Notes:

1. The California Department of Transportation adopts and publishes the California Manual on Uniform Traffic Control Devices (California MUTCD) to provide uniform standards and specifications for all official traffic control devices in California. Zero Emission Vehicle Signs and Pavement Markings can be found in the New Policies & Directives number 13-01. www.dot.ca.gov/hq/traffops/policy/13-01.pdf.
2. See Vehicle Code Section 22511 for EV charging spaces signage in off-street parking facilities and for use of EV charging spaces.
3. The Governor's Office of Planning and Research published a Zero-Emission Vehicle Community Readiness Guidebook which provides helpful information for local governments, residents and businesses. www.opr.ca.gov/ docs/ZEV_Guidebook.pdf.
4. Section 11B-812 of the California Building Code requires that a facility providing EVCS for public and common use also provide one or more accessible EVCS as specified in Table 11B-228.3.2.1.
5. It is encouraged that shared parking, EV Ready are designated as "EV preferred."

5.106.5.3.4 [N] Identification.

The raceway termination location shall be permanently and visibly marked as "EV Ready".

5.106.5.3.5 Deleted.

Section 12.26.030 Definitions.

For the purpose of this chapter, certain words and phrases used herein are defined as follows:

"Build It Green" means the Build It Green organization. Build It Green is a California professional non-profit membership organization whose mission is to promote healthy, energy and resource-efficient buildings.

"Green Point Rated" means the rating system developed by Build It Green.

"LEED" means the "Leadership in Energy and Environmental Design" program developed by the U.S. Green Building Council. The U.S. Green Building Council is a National professional non-profit membership organization whose mission is to promote buildings that are environmentally responsible.

"LEED Accredited Professional" means a person or organization determined by the Building Official to be qualified to perform inspections and provide documentation to assure compliance with the U.S. Green Building Council LEED requirements.

"Structural Renovations" means existing portions of roof framing and/or exterior walls removed for the purpose of rebuilding and remodeling.

"Qualified Green Building Professional" means a person trained through the USGBC as a "LEED AP" (accredited professional), or through Build It Green as a GreenPoint Rater, or other qualifications when acceptable to the Building Official. A certified green building professional, architect, designer, builder, or building inspector may be considered a qualified green building professional when determined appropriate by the Building Official.

"EV Capable" means a parking space linked to a listed electrical panel with sufficient capacity to provide at least 110/120 volts and 20 amperes to the parking space. Raceways linking the electrical panel and parking space only need to be installed in spaces that will be inaccessible in the future, either trenched underground or where penetrations to walls, floors, or other partitions would otherwise be required for future installation of branch circuits. Raceways must be at least 1" in diameter and may be sized for multiple circuits as allowed by the California Electrical Code. The panel circuit directory shall identify the overcurrent protective device space(s) reserved for EV charging as "EV CAPABLE." Construction documents shall indicate future completion of raceway from the panel to the parking space, via the installed inaccessible raceways.

"Level 1 EV Ready Space" means a parking space served by a complete electric circuit with a minimum of 110/120 volt, 20-ampere capacity including electrical panel capacity, overprotection device, a minimum 1" diameter raceway that may include multiple circuits as allowed by the California Electrical Code, wiring, and either a) a receptacle labelled "Electric Vehicle Outlet" with at least a ½" font adjacent to the parking space, or b) electric vehicle supply equipment (EVSE).

"Level 2 EV Ready Space" means a parking space served by a complete electric circuit with 208/240 volt, 40-ampere capacity including electrical panel capacity, overprotection device, a minimum 1" diameter raceway that may include multiple circuits as allowed by the California Electrical Code, wiring, and either a) a receptacle labelled "Electric Vehicle Outlet" with at least a ½" font adjacent to the parking space, or b) electric vehicle supply equipment (EVSE) with a minimum output of 30 amperes.

"Electric Vehicle Charging Station (EVCS)" means a parking space that includes installation of electric vehicle supply equipment (EVSE) with a minimum capacity of 30 amperes connected to a circuit serving a Level 2 EV Ready Space. EVCS installation may be used to satisfy a Level 2 EV Ready Space requirement.

"Automatic Load Management Systems (ALMS)" means a control system which allows multiple EV chargers or EV-Ready electric vehicle outlets to share a circuit or panel and automatically reduce power at each charger, providing the opportunity to reduce electrical infrastructure costs and/or provide demand response capability. ALMS systems must be designed to deliver at least 1.4kW to each EV Capable, EV Ready or EVCS space served by the ALMS. The connected amperage on-site shall not be lower than the required connected amperage per Part 11, 2019 California Green Building Code for the relevant building types.

"Affordable Housing" means residential buildings that entirely consist of units below market rate and whose rents or sales prices are governed my local agencies to be affordable based on area median income.

SECTION 3. CONSTITUTIONALITY.

If any section, subsection, sentence, clause or phrase of this code is for any reason held to be invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

SECTION 4. CEQA.

The City Council hereby finds and determines that this Ordinance has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines, § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. Adoption of the proposed Ordinance would not be an activity with potential to cause significant adverse effect on the environment because the changes made to the California Green Buildings Standards Code within are enacted to provide more protection to the environment, and therefore is exempt from CEQA. It is also exempt from CEQA pursuant to CEQA Guidelines, § 15308 which exempts actions taken by regulatory agencies for the enhancement and protection of the environment. As such, the Ordinance is categorically exempt from CEQA.

SECTION 5. PUBLICATION.

This Ordinance shall be published as provided in Government Code section 36933.

SECTION 6. EFFECTIVE DATE.

This Ordinance shall be effective upon the commencement of the thirty-first (31st) day following the adoption date.

The foregoing Ordinance was duly and properly introduced at a regular meeting of the City Council of the City of Los Altos held on _______, 2020 and was thereafter, at a regular meeting held on ____________, 2020 passed and adopted by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

____
Janis C. Pepper, Mayor

ATTEST

____
Andrea Chelemengos MMC, City Clerk

Electric Vehicle Charging Infrastructure

Electric Vehicle (EV) charging requirements in California can generally be broken into three categories:

1. EV Charging Installed: All supply equipment is installed at a parking space, such that an EV can charge without additional equipment.

2. EV Ready: Parking space is provided with all power supply and associated outlet, such that a charging station can be plugged in and thereby be ready to charge a vehicle.

3. EV Capable: Conduit is installed adjacent to a parking space area, and the building electrical system has ample capacity to serve future energy loads. An electrician would be required to install the conductor and associate outlets before charging is possible.

EV charging capacity and speed can be summarized as three categories:

- Level 1: Capable of charging at 120V, 20A. This is equivalent to a standard home outlet.

- Level 2: Capable of charging at 240V, 30-40A. This is the service capacity typically used for larger appliance loads in homes.

- Level 3 (DC Fast Charging): Capable of charging at 20-400kW. This is the type of charger used for Tesla Superchargers and DC Fast Chargers at some public or commercial sites.

Electric Vehicle Charging Stations (EVCS)- means a parking space that includes installation of electric vehicle supply equipment (EVSE) with a minimum capacity of 30 amperes connected to a circuit serving a Level 2 EV Ready Space. EVCS installation may be used to satisfy a Level 2 EV Ready Space requirement.

2019 California Green Building Code Requirements for EV Charging Infrastructure	Environmental Commission Recommended Requirements for EV Charging Infrastructure
Residential One- and Two-Family Dwellings and Townhouses (with attached or detached private garages)	
• Must be Level 2 EV Capable	• Install one Level 2 EV Ready Space for each dwelling unit • If two or more garage parking spaces are provided for a dwelling unit, install two Level 2 EV Ready Spaces

2019 California Green Building Code Requirements for EV Charging Infrastructure	Environmental Commission Recommended Requirements for EV Charging Infrastructure
Multifamily Dwellings [1 & 2]	
• 10% of parking spaces must be Level 2 EV Capable	For Residential Multi-Unit Dwelling, 20 or fewer units: • Install one Level 2 EV Ready Space for each dwelling unit
	For Residential: Multi-Unit Dwelling, >20 units: • 25% of the dwelling units with parking space(s) shall be provided with at least one Level 2 EV Ready Space • Remaining dwelling units with parking space(s) shall be provided with at least a Level 1 EV Ready Space
	For Multifamily Affordable Housing Units: • 10% of dwelling units with parking space(s) shall be provided with at least one Level 2 EV Ready Space • The remaining dwelling units with parking space(s) shall each be provided with at least a Level 1 EV Ready Space
Non-Residential [1 & 2]	
• 6% of parking spaces must be Level 2 EV Capable	For Office: • When 10 or more parking spaces are constructed, 10% of the available parking spaces on site shall be equipped with Level 2 EVCS; • An additional 30% shall be at least Level 2 EV Capable; and • An additional 10% shall be provided with at least Level 1 EV Ready Spaces
	For Non-Office: • When 10 or more parking spaces are constructed, 6% of the available parking spaces on site shall be equipped with Level 2 EVCS; • An additional 5% shall be at least Level 1 EV Ready

[1] For all percentages, calculations resulting in partial spaces shall be rounded up to the next whole number

[2] Exception: Installation of each Direct Current Fast Charger with the capacity to provide at least 80 kW output may substitute for six Level 2 EVCS and five EV Ready spaces after a minimum of six Level 2 EVCS and five Level 1 EV Ready spaces are installed.

Pacific Gas and Electric Company

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October 14, 2019

VIA EMAIL TO: Jon Biggs, Community Development Director
jbiggs@losaltosca.gov

Honorable Mayor and Members of the City Council
City of Los Altos
1 North San Antonio Road
Los Altos, CA 94022

Dear Honorable Mayor and Members of the City Council:

Pacific Gas and Electric Company (PG&E) is proud to provide electric and natural gas service to the City of Los Altos. And we are committed to helping customers and the community achieve their energy goals. As part of this commitment, PG&E welcomes the opportunity to support the City of Los Altos' efforts to promote efficient, all-electric new construction, when it is cost-effective.

PG&E strongly supports California's climate and clean air goals. We recognize that achieving these goals requires a range of approaches and tools, including increasing the use of energy-efficient electric appliances in buildings when cost-effective. PG&E welcomes the opportunity to avoid investments in new gas assets that might later prove underutilized as local governments and the state work together to realize long-term decarbonization objectives. With all this in mind, PG&E supports local government policies that promote all-electric new construction when cost effective.

Beyond new construction, PG&E believes a multi-faceted approach is needed to cost-effectively achieve California's broader economy-wide long-term GHG reduction objectives, including both electrification and decarbonizing the gas system with renewable natural gas and hydrogen. As California's decarbonization policies evolve, PG&E will continue to ensure the safe and reliable operation of the electric and gas systems to continue supporting the customers that depend on us.

PG&E appreciates the partnership with the City of Los Altos during its policy development process, which allows us to prepare for the future and continue providing the best service possible to customers. PG&E continuously forecasts load in its service territory and implements upgrades to the distribution grid to meet the demand. PG&E fully expects to meet the needs that all-electric buildings will require. PG&E remains ready to engage with our customers, local government, businesses, and community members to meet their needs safely, reliably, affordably, and with clean energy.

PG&E looks forward to continuing to work with the City of Los Altos to accomplish its policy goals.

Thank you, and have a safe day.

Sincerely,

Robert S. Kenney

Robert S. Kenney
Vice President

cc: Chris Jordan, City Manager [cjordan@losaltosca.gov]
Aimee Bailey, Ph.D., Director of Decarbonization and Grid Innovation, Silicon Valley Clean Energy [aimee.bailey@svcleanenergy.org]
Anna Brooks, Sr. Manager, Public Affairs, PG&E [anna.brooks@pge.com]
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ATTACHMENT 4

A STATEWIDE UTILITY PROGRAM

Title 24, Parts 6 and 11
Local Energy Efficiency Ordinances

2019 Nonresidential New Construction Reach Code Cost Effectiveness Study

Prepared for:
Christopher Kuch
Codes and Standards Program
Southern California Edison Company

Prepared by:
TRC
EnergySoft

Last Modified: July 25, 2019

ATTACHMENT 4

LEGAL NOTICE

This report was prepared by Southern California Edison Company (SCE) and funded by the California utility customers under the auspices of the California Public Utilities Commission.

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1 Introduction

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

This report documents cost-effective combinations of measures that exceed the minimum state requirements for design in newly-constructed nonresidential buildings. Buildings specifically examined include medium office, medium retail, and small hotels. Measures include energy efficiency, solar photovoltaics (PV), and battery storage. In addition, the report includes a comparison between a baseline mixed-fuel design and all-electric design for each occupancy type.

The Reach Code team analyzed the following seven packages as compared to 2019 code compliant mixed-fuel design baseline:

- **Package 1A – Mixed-Fuel + Energy Efficiency (EE):** Mixed-fuel design with energy efficiency measures and federal minimum appliance efficiencies.
- **Package 1B – Mixed-Fuel + EE + PV + Battery (B)**: Same as Package 1A, plus solar PV and batteries.
- **Package 1C – Mixed-fuel + High Efficiency (HE)**: Baseline code-minimum building with high efficiency appliances, triggering federal preemption. The intent of this package is to assess the standalone contribution that high efficiency appliances would make toward achieving high performance thresholds.
- **Package 2 – All-Electric Federal Code-Minimum Reference**: All-electric design with federal code minimum appliance efficiency. No solar PV or battery.
- **Package 3A – All-Electric + EE**: Package 2 all-electric design with energy efficiency measures and federal minimum appliance efficiencies.
- **Package 3B – All-Electric + EE + PV + B**: Same as Package 3A, plus solar PV and batteries.
- **Package 3C – All-Electric + HE**: All-electric design with high efficiency appliances, triggering federal preemption.

Figure 1 summarizes the baseline and measure packages. Please refer to *Section 3* for more details on the measure descriptions.

Figure 1. Measure Category and Package Overview

Measure Category	Report Section	Mixed Fuel				All-Electric			
		Baseline	1A	1B	1C	2	3A	3B	3C
		Fed Code Minimum Efficiency	EE	EE+ PV + B	HE	Fed Code Minimum Efficiency	EE	EE+ PV + B	HE
Energy Efficiency Measures	3.1		X	X			X	X	
Solar PV + Battery	3.2			X				X	
All-Electric Measures	3.3					X	X	X	X
Preemptive Appliance Measures	3.4				X				X

The team separately developed cost effectiveness results for PV-only and PV+Battery packages, excluding any efficiency measures. For these packages, the PV is modeled as a "minimal" size of 3 kW and a larger size based on the available roof area and electric load of the building. PV sizes are combined with two sizes of battery storage for both mixed fuel and all electric buildings to form eight different package combinations as outlined below:

- **Mixed-Fuel + 3 kW PV Only**
- **Mixed-Fuel + 3 kW PV + 5 kWh Battery**
- **Mixed-Fuel + PV Only:** PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller
- **Mixed-Fuel + PV + 50 kWh Battery:** PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller, along with 50 kWh battery
- **All-Electric + 3 kW PV Only**
- **All-Electric + 3 kW PV + 5 kWh Battery**
- **All-Electric + PV Only:** PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller
- **All-Electric + PV + 50 kWh Battery:** PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller, along with 50 kWh battery.

Each of the eight packages are evaluated against a baseline model designed as per 2019 Title 24 Part 6 requirements. The Standards baseline for all occupancies in this report is a mixed-fuel design.

The Department of Energy (DOE) sets minimum efficiency standards for equipment and appliances that are federally regulated under the National Appliance Energy Conservation Act (NAECA), including heating, cooling, and water heating equipment.[1] Since state and local governments are prohibited from adopting

[1] https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=8de751f141aaa1c1c9833b36156faf67&mc=true&n=pt10.3.431&r=PART&ty=HTML#se10.3.431_197

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 equipment. However, because high efficiency appliances are often the easiest and most affordable measures to increase energy performance, this study provides an analysis of high efficiency appliances for informational purposes. While federal preemption would limit a reach code, in practice, builders may install any package of compliant measures to achieve the performance requirements, including higher efficiency appliances that are federally regulated.

2 Methodology and Assumptions

With input from several stakeholders, the Reach Codes team selected three building types—medium office, medium retail, and small hotel—to represent a predominant segment of nonresidential new construction in the state.

This analysis used both on-bill and time dependent valuation of energy (TDV) based approaches to evaluate cost-effectiveness. Both methodologies require estimating and quantifying the energy savings associated with energy efficiency measures, as well as quantifying the costs associated with the measures. The main difference between the methodologies is the valuation of energy and thus the cost savings of reduced or avoided energy use. 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. With the TDV approach, electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods.[2]

The Reach Code Team performed energy simulations using EnergyPro 8.0 software for 2019 Title 24 code compliance analysis, which uses CBECC-Com 2019.1.0 for the calculation engine. The baseline prototype models in all climate zones have been designed to have compliance margins as close as possible to 0 to reflect a prescriptively-built building.[3]

2.1 Building Prototypes

The DOE provides building prototype models which, when modified to comply with 2019 Title 24 requirements, can be used to evaluate the cost effectiveness of efficiency measures. These prototypes have historically been used by the California Energy Commission to assess potential code enhancements. The Reach Code Team performed analysis on a medium office, a medium retail, and a small hotel prototype.

Water heating includes both service water heating (SWH) for office and retail buildings and domestic hot water for hotels. In this report, water heating or SWH is used to refer to both. The Standard Design HVAC and SWH systems are based on the system maps included in the 2019 Nonresidential Alternate

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[2] Horii, B., E. Cutter, N. Kapur, J. Arent, and D. Conotyannis. 2014. "Time Dependent Valuation of Energy for Developing Building Energy Efficiency Standards." Available at: http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09_workshop/2017_TDV_Documents

[3] EnergySoft and TRC were able to develop most baseline prototypes to achieve a compliance margin of less than +/-1 percent except for few models that were at +/- 6 percent. This indicates these prototypes are not exactly prescriptive according to compliance software calculations. To calculate incremental impacts, TRC conservatively compared the package results to that of the proposed design of baseline prototypes (not the standard design).

Calculation Method Reference Manual.[4] The Standard Design is the baseline for all nonresidential projects and assumes a mixed-fuel design using natural gas as the space heating source in all cases. Baseline HVAC and SWH system characteristics are described below and in Figure 2:

- The baseline medium office HVAC design package includes two gas hot water boilers, three packaged rooftop units (one for each floor), and variable air volume (VAV) terminal boxes with hot water reheat coils. The SWH design includes one 8.75 kW electric resistance hot water heater with a 30-gallon storage tank.
- The baseline medium retail HVAC design includes five single zone packaged rooftop units (variable flow and constant flow depending on the zone) with gas furnaces for heating. The SWH design includes one 8.75 kW electric resistance hot water heater with a 30-gallon storage tank.
- The small hotel has two baseline equipment systems, one for the nonresidential spaces and one for the guest rooms.
  - The nonresidential HVAC design includes two gas hot water boilers, four packaged rooftop units and twelve VAV terminal boxes with hot water reheat coils. The SWH design include a small electric resistance water heater with 30-gallon storage tank.
  - The residential HVAC design includes one single zone air conditioner (AC) unit with gas furnace for each guest room and the water heating design includes one central gas water heater with a recirculation pump for all guest rooms.

Figure 2. Prototype Characteristics Summary

	Medium Office	Medium Retail	Small Hotel
Conditioned Floor Area	53,628	24,691	42,552
Number of Stories	3	1	4
Number of Guest Rooms	0	0	78
Window-to-Wall Area Ratio	0.33	0.07	0.11
Baseline HVAC System	Packaged DX VAV with gas furnaces + VAV terminal units with hot water reheat. Central gas hot water boilers	Single zone packaged DX units with gas furnaces	Nonresidential: Packaged DX VAV with hot water coil + VAV terminal units with hot water reheat. Central gas hot water boilers. Residential: Single zone DX AC unit with gas furnaces
Baseline Water Heating System	30-gallon electric resistance water heater	30-gallon electric resistance water heater	Nonresidential: 30-gallon electric resistance water heater Residential: Central gas water heater with recirculation loop

[4] Nonresidential Alternative Calculation Method Reference Manual For the 2019 Building Energy Efficiency Standards. Available at: https://www.energy.ca.gov/2019publications/CEC-400-2019-006/CEC-400-2019-006-CMF.pdf

2.2 Cost Effectiveness

The Reach Code Team analyzed the cost effectiveness of the packages by applying them to building prototypes (as applicable) using the life cycle cost methodology, which is approved and used by the Energy Commission to establish cost effective building energy standards (Title 24, Part 6).[5]

Per Energy Commission's methodology, the Reach Code Team assessed the incremental costs of the energy efficiency measure packages and compared them to the energy cost savings over the measure life of 15 years. Incremental costs represent the equipment, installation, replacements, and maintenance costs of the proposed measure relative to the 2019 Title 24 Standards minimum requirements. The energy savings benefits are estimated using both TDV of energy and typical utility rates for each building type:

- **Time Dependent Valuation:** TDV is a normalized monetary format developed and used by the Energy Commission for comparing electricity and natural gas savings, and it considers the cost of electricity and natural gas consumed during different times of the day and year. Simulation outputs are translated to TDV savings benefits using 2019 TDV multipliers and 15-year discounted costs for the nonresidential measure packages.
- **Utility bill impacts (On-bill):** Utility energy costs are estimated by applying appropriate IOU rates to estimated annual electricity and natural gas consumption. The energy bill savings are calculated as the difference in utility costs between the baseline and proposed package over a 15-year duration accounting for discount rate and energy cost escalation.

In coordination with the IOU rate team, and rate experts at a few electric publicly owned utilities (POUs), the Reach Code Team used the current nonresidential utility rates publicly available at the time of analysis to analyze the cost effectiveness for each proposed package. The utility tariffs, summarized in Figure 3, were determined based on the annual load profile of each prototype, and the most prevalent rate in each territory. For some prototypes there are multiple options for rates because of the varying load profiles of mixed-fuel buildings versus all-electric buildings. Tariffs were integrated in EnergyPro software to be applied to the hourly electricity and gas outputs. The Reach Code Team did not attempt to compare or test a variety of tariffs to determine their impact on cost effectiveness.

The currently available and applicable time-of–use (TOU) nonresidential rates are applied to both the base and proposed cases with PV systems.[6] Any annual electricity production in excess of annual electricity consumption is credited at the applicable wholesale rate based on the approved NEM tariffs for that utility. For a more detailed breakdown of the rates selected refer to *Appendix 6.4 Utility Rate Schedules*. Note that most utility time-of-use rates will be updated in the near future, which can affect cost effectiveness results. For example, Pacific Gas and Electric Company (PG&E) will introduce new rates for new service connections in late 2019, and existing accounts will be automatically rolled over to new rates in November 2020.

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[5] Architectural Energy Corporation (January 2011) Life-Cycle Cost Methodology. California Energy Commission. Available at: http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/general_cec_documents/2011-01-14_LCC_Methodology_2013.pdf

[6] Under NEM rulings by the CPUC (D-16-01-144, 1/28/16), all new PV customers shall be in an approved TOU rate structure. As of March 2016, all new PG&E net energy metering (NEM) customers are enrolled in a time-of-use rate. (http://www.pge.com/en/myhome/saveenergymoney/plans/tou/index.page?).

Figure 3. Utility Tariffs used based on Climate Zone

Climate Zones	Electric / Gas Utility	Electricity (Time-of-use)	Natural Gas
	IOUs		
1-5,11-13,16	PG&E	A-1/A-10	G-NR1
5	PG&E / Southern California Gas Company	A-1/A-10	G-10 (GN-10)
6,8-10,14,15	SCE / Southern California Gas Company	TOU-GS-1/TOU-GS-2/TOU-GS-3	G-10 (GN-10)
7,10,14	San Diego Gas and Electric Company (SDG&E)	A-1/A-10	GN-3
	Electric POUs		
4	City of Palo Alto (CPAU)	E-2	n/a
12	Sacramento Municipal Utility District (SMUD)	GS	n/a
6,7,8,16	Los Angeles Department of Water and Power (LADWP)	A-2 (B)	n/a

The Reach Code Team obtained measure costs through interviews with contractors and California distributors and review of online sources, such as Home Depot and RS Means. Taxes and contractor markups were added as appropriate. Maintenance costs were not included because there is no assumed maintenance on the envelope measures. For HVAC and SWH measures the study assumes there are no additional maintenance cost for a more efficient version of the same system type as the baseline. Replacement costs for inverters were included for PV systems, but the useful life all other equipment exceeds the study period.

The Reach Code Team compared the energy benefits with incremental measure cost data to determine cost effectiveness for each measure package. The calculation is performed for a duration of 15 years for all nonresidential prototypes with a 3 percent discount rate and fuel escalation rates based on the most recent General Rate Case filings and historical escalation rates.[7] Cost effectiveness is presented using net present value and benefit-to-cost ratio metrics.

- **Net Present Value (NPV)**: The Reach Code Team uses net savings (NPV benefits *minus* NPV costs) as the cost effectiveness metric. If the net savings of a measure or package is positive, it is considered cost effective. Negative savings represent net costs. A measure that has negative energy cost benefits (energy cost increase) can still be cost effective if the costs to implement the measure are more negative (i.e., material and maintenance cost savings).
- **Benefit-to-Cost Ratio (B/C)**: 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 criteria 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.

[7] 2019 TDV Methodology Report, California Energy Commission, Docket number: 16-BSTD-06 https://efiling.energy.ca.gov/GetDocument.aspx?tn=216062

There are several special circumstances to consider when reviewing these results:

- Improving the efficiency of a project often requires an initial incremental investment. 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). Typically, utility bill savings are categorized as a 'benefit' while incremental construction costs are treated as 'costs.' In cases where both construction costs are negative and utility bill savings are negative, the construction cost savings are treated as the 'benefit' while the utility bill negative savings are the 'cost.'
- In cases where a measure package is cost effective immediately (i.e., there are upfront cost savings and lifetime energy cost savings), cost effectiveness is represented by ">1".
- The B/C ratios sometimes appear very high even though the cost numbers are not very high (for example, an upfront cost of $1 but on-bill savings of $200 over 30 years would equate to a B/C ratio of 200). NPV is also displayed to clarify these potentially confusing conclusions – in the example, the NPV would be equal to a modest $199.

3 Measure Description and Cost

Using the 2019 Title 24 code baseline as the starting point, The Reach Code Team identified potential measure packages to determine the projected energy (therm and kWh) and compliance impacts. The Reach Code Team developed an initial measure list based on experience with designers and contractors along with general knowledge of the relative acceptance and preferences of many measures, as well as their incremental costs.

The measures are categorized into energy efficiency, solar PV and battery, all-electric, and preempted high efficiency measures in subsections below.

3.1 Energy Efficiency Measures

This section describes all the energy efficiency measures considered for this analysis to develop a non-preempted, cost-effective efficiency measure package. The Reach Code Team assessed the cost-effectiveness of measures for all climate zones individually and found that the packages did not need to vary by climate zone, with the exception of a solar heat gain coefficient measure in hotels, as described in more detail below. The measures were developed based on reviews of proposed 2022 Title 24 codes and standards enhancement measures, as well as ASHRAE 90.1 and ASHRAE 189.1 Standards. Please refer to *Appendix Section 6.86.7* for a list of efficiency measures that were considered but not implemented.

Figure 4 provides a summary of the cost of each measure and the applicability of each measure to the prototype buildings.

3.1.1 Envelope

- **Modify Solar Heat Gain Coefficient (SHGC) fenestration**
  - Office and Retail - All Climate Zones: reduce window SHGC from the prescriptive value of 0.25 to 0.22
  - Hotel
    - Climate zones 1, 2, 3, 5, and 16: Increase the SHGC for all nonresidential spaces from the prescriptive value of 0.25 to 0.45 in both common and guest room spaces.
    - Climate zones 4, and 6-15: Reduce window SHGC from the prescriptive value of 0.25 to 0.22, only for common spaces.

  In all cases, the fenestration visible transmittance and U-factor remain at prescriptive values.
- **Fenestration as a function of orientation**: Limit the amount of fenestration area as a function of orientation. East-facing and west-facing windows are each limited to one-half of the average amount of north-facing and south-facing windows.

3.1.2 HVAC and SWH

- **Drain water heat recovery (DWHR)**: Add shower drain heat recovery in hotel guest rooms. DWHR captures waste heat from a shower drain line and uses it to preheat hot water. Note that this measure cannot currently be modeled on hotel/motel spaces, and the Reach Code Team integrated estimated savings outside of modeling software based on SWH savings in residential scenarios. Please see *Appendix Section 6.3* for details on energy savings analysis.
- **VAV box minimum flow**: Reduce VAV box minimum airflows from the current T24 prescriptive requirement of 20 percent of maximum (design) airflow to the T24 zone ventilation minimums.
- **Economizers on small capacity systems**: Require economizers and staged fan control in units with cooling capacity ≥ 33,000 Btu/hr and ≤ 54,000 Btu/hr, which matches the requirement in the 2018 International Green Construction Code and adopts ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1. This measure reduces the T24 prescriptive threshold on air handling units that are required to have economizers, which is > 54,000 Btu/hr.
- **Solar thermal hot water:** For all-electric hotel only, add solar thermal water heating to supply the following portions of the water heating load, measured in solar savings fraction (SSF):
  - 20 percent SSF in CZs 2, 3, and 5-9
  - 25 percent in CZ4
  - 35 percent SSF in CZs 1 and 10-16.

3.1.3 Lighting

- **Interior lighting reduced lighting power density (LPD)**: Reduce LPD by 15 percent for Medium Office, 10 percent for Medium Retail and by 10 percent for the nonresidential areas of the Small Hotel.
- **Institutional tuning**: Limit the maximum output or maximum power draw of lighting to 85 percent of full light output or full power draw.
- **Daylight dimming plus off**: Turn daylight-controlled lights completely off when the daylight available in the daylit zone is greater than 150 percent of the illuminance received from the general lighting system at full power. There is no associated cost with this measure, as the 2019 T24 Standards already require multilevel lighting and daylight sensors in primary and secondary daylit spaces. This measure is simply a revised control strategy and does not increase the number of sensors required or labor to install and program a sensor.
- **Occupant sensing in open plan offices**: In an open plan office area greater than 250 ft^2, control lighting based on occupant sensing controls. Two workstations per occupancy sensor.

Details on the applicability and impact of each measure by building type and by space function can be found in *Appendices 6.2*. The appendix also includes the resulting LPD that is modeled as the proposed by building type and by space function.

Figure 4. Energy Efficiency Measures - Specification and Cost

Measure	Baseline T24 Requirement	Measure Applicability ● Included in Packages 1A, 1B, 3A, 3C – Not applicable				Incremental Cost	Sources & Notes
		Med Office	Med Retail	Small Hotel Guest rooms	Small Hotel Comm Spaces		
Envelope							
Modify SHGC Fenestration	SHGC of 0.25	●	●	●	●	\$1.60 /ft^2 window for SHGC decreases, \$0/ft^2 for SHGC increases	Costs from one manufacturer.
Fenestration as a Function of Orientation	Limit on total window area and west-facing window area as a function of wall area.	●	–	–	–	\$0	No additional cost associated with the measure which is a design consideration not an equipment cost.
HVAC and SHW							
Drain Water Heat Recovery	No heat recovery required	–	–	●	–	\$841 /unit	Assume 1 heat recovery unit for every 3 guestrooms. Costs from three manufacturers.
VAV Box Minimum Flow	20 percent of maximum (design) airflow	●	–	–	●	\$0	No additional cost associated with the measure which is a design consideration not an equipment cost.
Economizers on Small Capacity Systems	Economizers required for units > 54,000 Btu/hr	–	●	–	–	\$2,857 /unit	Costs from one manufacturer's representative and one mechanical contractor.

Measure	Baseline T24 Requirement	Measure Applicability ● Included in Packages 1A, 1B, 3A, 3C – Not applicable				Incremental Cost	Sources & Notes
		Med Office	Med Retail	Small Hotel Guest rooms	Small Hotel Comm Spaces		
Solar Thermal Hot Water	For central heat pump water heaters, there is no prescriptive baseline requirement.	–	–	● (electric only)	–	\$33/therm-yr	Installed costs reported in the California Solar Initiative Thermal Program Database, 2015-present.[8] Costs include tank and were only available for gas backup systems. Costs are reduced by 19 percent per federal income tax credit average through 2022.
Lighting							
Interior Lighting Reduced LPD	Per Area Category Method, varies by Primary Function Area. Office area 0.60 – 0.70 W/ft^2 depending on area of space. Hotel function area 0.85 W/ft^2. Retail Merchandise Sales 1.00 W/ft^2	●	●	–	●	\$0	Industry report on LED pricing analysis shows that costs are not correlated with efficacy.[9]

[8] http://www.csithermalstats.org/download.html

[9] http://calmac.org/publications/LED_Pricing_Analysis_Report_-_Revised_1.19.2018_Final.pdf

Measure	Baseline T24 Requirement	Measure Applicability ● Included in Packages 1A, 1B, 3A, 3C – Not applicable				Incremental Cost	Sources & Notes
				Small Hotel			
		Med Office	Med Retail	Guest rooms	Comm Spaces		
Institutional Tuning	No requirement, but Power Adjustment Factor (PAF) credit of 0.10 available for luminaires in non-daylit areas and 0.05 for luminaires in daylit areas[10]	●	●	–	●	$0.06/ft^2$	Industry report on institutional tuning[11]
Daylight Dimming Plus Off	No requirement, but PAF credit of 0.10 available.	●	–	–	–	$0	Given the amount of lighting controls already required, this measure is no additional cost.
Occupant Sensing in Open Plan Offices	No requirement, but PAF credit of 0.30 available.	●	–	–	–	$189 /sensor; $74 /powered relay; $108 /secondary relay	2 workstations per sensor; 1 fixture per workstation; 4 workstations per master relay; 120 ft^2/workstation in open office area, which is 53% of total floor area of the medium office

[10] Power Adjustment Factors allow designers to tradeoff increased lighting power densities for more efficient designs. In this study, PAF-related measures assume that the more efficient design is incorporated without a tradeoff for increased lighting power density.

[11] https://slipstreaminc.org/sites/default/files/2018-12/task-tuning-report-mndoc-2015.pdf

3.2 Solar Photovoltaics and Battery Measures

This section describes the PV and battery measures considered for this analysis. The Reach Code Team estimated the required PV sizes for each building prototype for the efficiency measure packages and the stand alone PV and battery options.

3.2.1 Solar Photovoltaics

2019 Title 24 requires nonresidential buildings to reserve at least 15 percent of the roof area as a "solar zone," but does not include any requirements or compliance credits for the installation of photovoltaic systems. The Reach Code Team analyzed a range of PV system sizes to determine cost effectiveness. To determine upper end of potential PV system size, the Reach Code Team assumed a PV generation capacity of either

- 15 W/ft^2 covering 50 percent of the roof area, or
- Enough to nearly offset the annual energy consumption.

The medium office and small hotel prototypes had small roof areas compared to their annual electricity demand, thus the PV system capacity at 50 percent of the roof area was less than the estimated annual usage. The medium office and small hotel had a 135 kW and 80 kW array, respectively. The medium retail building has a substantially large roof area that would accommodate a PV array that generates more than the annual electricity load of the building. The PV array for the medium retail building was sized at 110 kW to not exceed the annual electricity consumption of the building when accounting for the minimum annual energy demand across climate zones with efficiency packages.

The modeling software for nonresidential buildings does not allow auto-sizing of PV based on a desired percent offset of electricity use. Moreover, the PV size is also constrained by the availability of roof area. Hence, a common size of PV is modeled for all the packages including all electric design. Figure 5 through Figure 7 below demonstrate the percent of electricity offset by PV for both mixed fuel and all electric buildings over their respective federal minimum design package.

Figure 5. Medium Office – Annual Percent kWh Offset with 135 kW Array

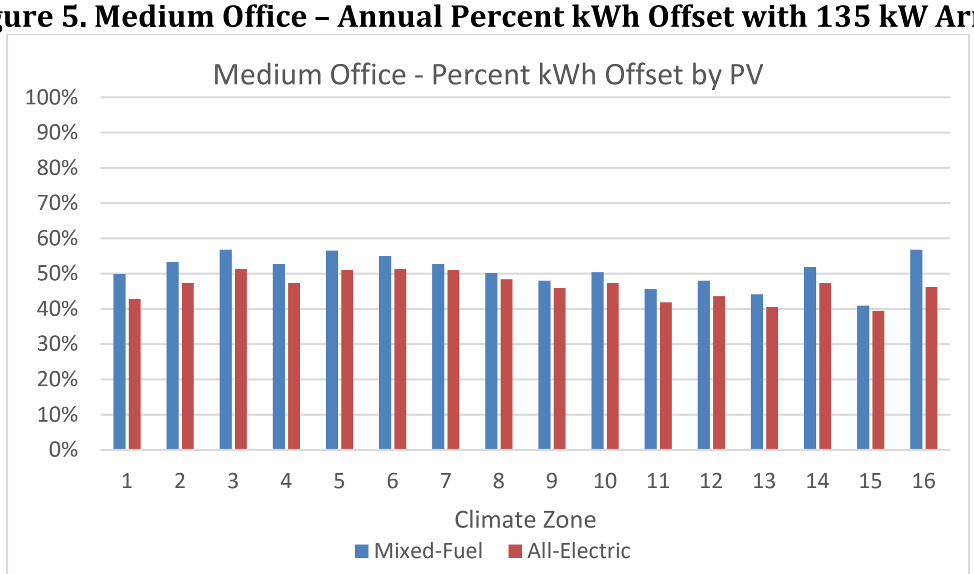


Figure 6. Medium Retail – Annual Percent kWh Offset with 110 kW Array

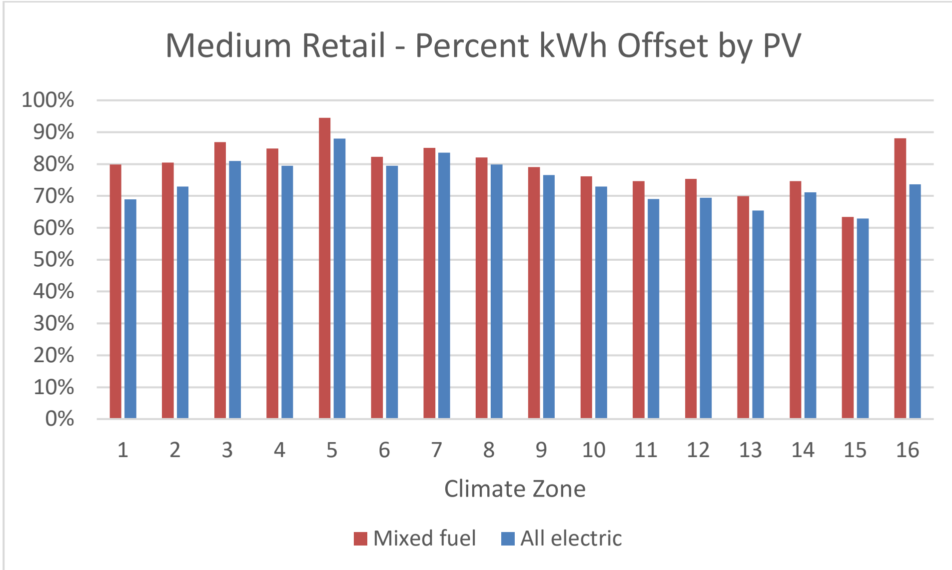
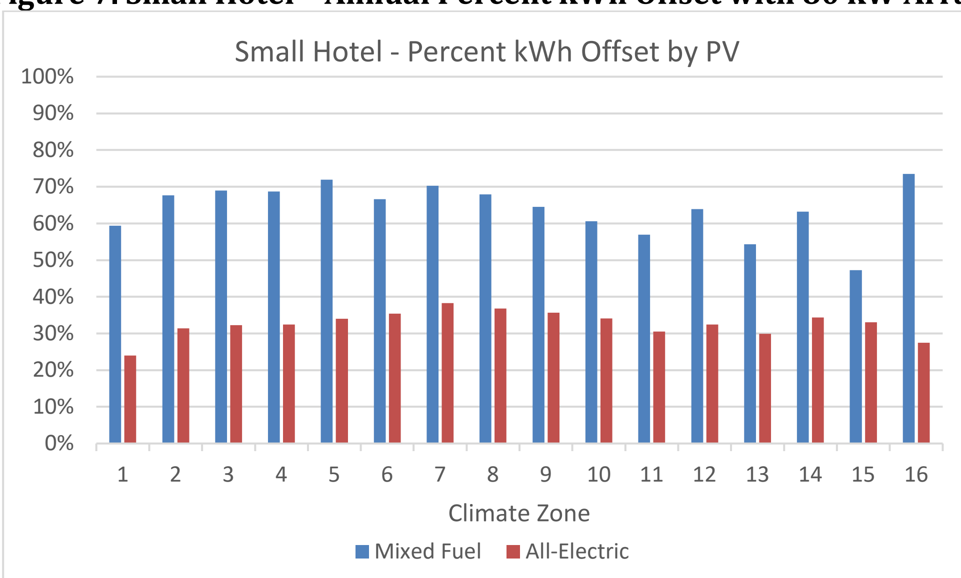


Figure 7. Small Hotel – Annual Percent kWh Offset with 80 kW Array



The costs for PV include first cost to purchase and install the system, inverter replacement costs, and annual maintenance costs. A summary of the medium office costs and sources is given in Figure 8. Upfront solar PV system costs are reduced by the federal income tax credit (ITC), approximately 19 percent due to a phased reduction in the credit through the year 2022.[12]

[12] The federal credit drops to 26% in 2020, and 22% in 2021 before dropping permanently to 10% for commercial projects and 0% for residential projects in 2022. More information on federal Investment Tax Credits available at: https://www.seia.org/initiatives/solar-investment-tax-credit-itc

Figure 8. Medium Office Upfront PV Costs

	Unit Cost	Cost	Useful Life (yrs.)	Source
Solar PV System	$2.30 / Wdc	$310,500	30	National Renewable Energy Laboratory (NREL) Q1 2016[13]
Inverter Replacement	$0.15 / Wdc	$20,250	10	E3 Rooftop Solar PV System Report[14]
Maintenance Costs	$0.02 / Wdc	$2,700	1	

PV energy output is built into CBECC-Com and is based on NREL's PVWatts calculator, which includes long term performance degradation estimates.[15]

3.2.2 Battery Storage

This measure includes installation of batteries to allow energy generated through PV to be stored and used later, providing additional energy cost benefits. This report does not focus on optimizing battery sizes or controls for each prototype and climate zone, though the Reach Code Team ran test simulations to assess the impact of battery sizes on TDV savings and found diminishing returns as the battery size increased.

The team set battery control to the Time of Use Control (TOU) method, which assumes batteries are charged anytime PV generation is greater than the building load but discharges to the electric grid beginning during the highest priced hours of the day (the "First Hour of the Summer Peak"). Because there is no default hour available in CBECC-Com, the team applied the default hour available in CBECC-Res to start discharging (hour 19 in CZs 2, 4, and 8-15, and hour 20 in other CZs). This control option is most reflective of the current products on the market. While this control strategy is being used in the analysis, there would be no mandate on the control strategy used in practice.

The current simulation software has approximations of how performance characteristics change with environmental conditions, charge/discharge rates, and degradation with age and use. More information is on the software battery control capabilities and associated qualification requirements are available in the Residential Alternative Calculation Method Reference Manual and the 2019 Reference Appendices for the 2019 Title 24 Standards.[16,17]

The Reach Code Team used costs of $558 kWh based on a 2018 IOU Codes and Standards Program report, assuming a replacement is necessary in year 15.[18] Batteries are also eligible for the ITC if they are installed at the same time as the renewable generation source and at least 75 percent of the energy used to charge

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13 Available at: https://www.nrel.gov/docs/fy16osti/66532.pdf

14 Available at: https://efiling.energy.ca.gov/getdocument.aspx?tn=221366

15 More information available at: https://pvwatts.nrel.gov/downloads/pvwattsv5.pdf

16 Battery controls are discussed in Sections 2.1.5.4 and Appendix D of the Residential Alternative Calculation Method Reference Manual, available here: https://ww2.energy.ca.gov/2019publications/CEC-400-2019-005/CEC-400-2019-005-CMF.pdf

17 Qualification Requirements for Battery Storage Systems are available in JA12 of the 2019 Reference Appendices: https://ww2.energy.ca.gov/2018publications/CEC-400-2018-021/CEC-400-2018-021-CMF.pdf

18 Available at: http://localenergycodes.com/download/430/file_path/fieldList/PV%20Plus%20Battery%20Storage%20Report

the battery comes from a renewable source. Thus, the Reach Code Team also applied a 19 percent cost reduction to battery costs.

3.2.3 PV-only and PV+Battery Packages

The Reach Code Team analyzed solar PV and battery storage only, without other efficiency measures in both mixed-fuel and all-electric building designs. Two different sizes of solar PV and battery storage were analyzed.

- **Small PV Size**: 3 kW, assumed to be the minimal PV system considered for installation in a nonresidential building.
- **Large PV Size**: PV capacity equal to 15 W/ft^2 over 50 percent of the roof area, or sized to nearly offset annual electricity consumption, as described in Section 3.2.1.
- **Small Battery Size:** 5 kWh, assumed to be the minimal battery system considered for installation in a nonresidential building, and representative of smaller products currently available on the market.
- **Large Battery Size:** 50 kWh, assumed to be a substantially large size for a nonresidential setting. Generally, the reach code team found diminishing on-bill and TDV benefits as the battery size increased.

As described in Section 1 and Section 4.4, each PV size was run as a standalone measure. When packaged with a battery measure, the small PV size was paired with the small battery size, and the large PV size was paired with the large battery size.

3.3 All Electric Measures

The Reach Code Team investigated the cost and performance impacts and associated infrastructure costs associated with changing the baseline HVAC and water heating systems to all-electric equipment. This includes heat pump space heating, electric resistance reheat coils, electric water heater 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. The Reach Code Team selected electric systems that would be installed instead of gas-fueled systems in each prototype.

3.3.1 HVAC and Water Heating

The nonresidential standards use a mixed-fuel baseline for the Standard Design systems. In most nonresidential occupancies, the baseline is natural gas space heating. Hotel/motels and high-rise residential occupancies also assume natural gas baseline water heating systems for the guest rooms and dwelling units. In the all-electric scenario, gas equipment serving these end-uses is replaced with electric equipment, as described in Figure 9.

Figure 9. All-Electric HVAC and Water Heating Characteristics Summary.

		Medium Office	Medium Retail	Small Hotel
HVAC System	Baseline	Packaged DX + VAV with HW reheat. Central **gas** boilers.	Single zone packaged DX with **gas** furnaces	NonRes: Packaged DX + VAV with HW reheat. Central **gas** boilers. Res: Single zone DX AC unit with **gas** furnaces
	Proposed All-Electric	Packaged DX + VAV with electric **resistance** reheat.	Single zone packaged **heat pumps**	NonRes: Packaged DX + VAV with electric **resistance** reheat Res: Single zone **heat pumps**
Water Heating System	Baseline	Electric **resistance** with storage	Electric **resistance** with storage	NonRes: **Electric** resistance storage Res: Central **gas** storage with recirculation
	Proposed All-Electric	Electric **resistance** with storage	Electric **resistance** with storage	NonRes: Electric **resistance** storage Res: Individual **heat pumps**

The Reach Code Team received cost data for baseline mixed-fuel equipment as well as electric equipment from an experienced mechanical contractor in the San Francisco Bay Area. The total construction cost includes equipment and material, labor, subcontractors (for example, HVAC and SHW control systems), and contractor overhead.

3.3.1.1 Medium Office

The baseline HVAC system includes two gas hot water boilers, three packaged rooftop units, and VAV hot water reheat boxes. The SHW design includes one 8.75 kW electric resistance hot water heater with a 30-gallon storage tank.

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, the Reach Code Team determined that the most feasible all-electric HVAC system, given the software modeling constraints 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.

Note that the actual natural 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.[19]

[19] 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

If these losses are considered savings for the electric resistance reheat (which has zero associated distribution loss) may be higher.

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 Figure 10. 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 climate zones.

Figure 10. Medium Office HVAC System Costs

Climate Zone	Mixed Fuel Baseline	All Electric System	Incremental cost for All-Electric
CZ01	$1,202,538	$1,106,432	$(96,106)
CZ02	$1,261,531	$1,178,983	$(82,548)
CZ03	$1,205,172	$1,113,989	$(91,183)
CZ04	$1,283,300	$1,205,434	$(77,865)
CZ05	$1,207,345	$1,113,989	$(93,356)
CZ06	$1,216,377	$1,131,371	$(85,006)
CZ07	$1,227,932	$1,148,754	$(79,178)
CZ08	$1,250,564	$1,172,937	$(77,626)
CZ09	$1,268,320	$1,196,365	$(71,955)
CZ10	$1,313,580	$1,256,825	$(56,755)
CZ11	$1,294,145	$1,221,305	$(72,840)
CZ12	$1,274,317	$1,197,121	$(77,196)
CZ13	$1,292,884	$1,221,305	$(71,579)
CZ14	$1,286,245	$1,212,236	$(74,009)
CZ15	$1,357,023	$1,311,994	$(45,029)
CZ16	$1,295,766	$1,222,817	$(72,949)

3.3.1.2 Medium Retail

The baseline HVAC system includes five 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 8.75 kW electric resistance hot water heater with a 30-gallon storage tank.

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.

Cost data for medium retail designs are presented in Figure 11. Costs for rooftop air-conditioning systems are very similar to rooftop heat pump systems.

Figure 11. Medium Retail HVAC System Costs

Climate Zone	Mixed Fuel Baseline	All Electric System	Incremental cost for All-Electric
CZ01	$328,312	$333,291	$4,978
CZ02	$373,139	$373,702	$563
CZ03	$322,849	$326,764	$3,915
CZ04	$329,900	$335,031	$5,131
CZ05	$359,888	$362,408	$2,520
CZ06	$335,728	$341,992	$6,265
CZ07	$345,544	$349,808	$4,265
CZ08	$368,687	$369,792	$1,104
CZ09	$415,155	$411,069	$(4,087)
CZ10	$345,993	$346,748	$755
CZ11	$418,721	$414,546	$(4,175)
CZ12	$405,110	$400,632	$(4,477)
CZ13	$376,003	$375,872	$(131)
CZ14	$405,381	$406,752	$1,371
CZ15	$429,123	$427,606	$(1,517)
CZ16	$401,892	$404,147	$2,256

3.3.1.3 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 twelve VAV terminal boxes with hot water reheat coil. The SHW design includes a small electric water heater with storage tank. The residential 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 to remain a small electric resistance water heater.

For the guest room all-electric HVAC system, the analysis used a single zone (packaged terminal) heat pump and a central heat pump water heater serving all guest rooms. Central heat pump water heating with recirculation serving guest rooms cannot yet be modeled in CBECC-Com, and energy impacts were modeled by simulating individual heat pump water heaters in each guest room. The reach code team believes this is a conservative assumption, since individual heat pump water heaters will have much higher tank standby losses. The Reach Code Team attained costs for central heat pump water heating installation including storage tanks and controls and used these costs in the study.

Cost data for small hotel designs are presented in Figure 12. The all-electric design presents substantial cost savings because there is no hot water plant or piping distribution system serving the nonresidential spaces, as well as the lower cost of packaged terminal heat pumps serving the residential spaces compared to split DX/furnace systems with individual flues.

Figure 12. Small Hotel HVAC and Water Heating System Costs

Climate Zone	Mixed Fuel Baseline	All Electric System	Incremental cost for All-Electric
CZ01	$2,337,531	$1,057,178	$(1,280,353)
CZ02	$2,328,121	$1,046,795	$(1,281,326)
CZ03	$2,294,053	$1,010,455	$(1,283,598)
CZ04	$2,302,108	$1,018,675	$(1,283,433)
CZ05	$2,298,700	$1,015,214	$(1,283,486)
CZ06	$2,295,380	$1,011,753	$(1,283,627)
CZ07	$2,308,004	$1,026,029	$(1,281,975)
CZ08	$2,333,662	$1,053,717	$(1,279,946)
CZ09	$2,312,099	$1,030,355	$(1,281,744)
CZ10	$2,354,093	$1,075,348	$(1,278,745)
CZ11	$2,347,980	$1,068,426	$(1,279,554)
CZ12	$2,328,654	$1,047,660	$(1,280,994)
CZ13	$2,348,225	$1,068,858	$(1,279,367)
CZ14	$2,345,988	$1,066,263	$(1,279,725)
CZ15	$2,357,086	$1,079,241	$(1,277,845)
CZ16	$2,304,094	$1,019,973	$(1,284,121)

3.3.2 Infrastructure Impacts

Electric heating appliances and equipment often require a larger electrical connection than an equivalent natural 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.

3.3.2.1 Electrical Panel Sizing and Wiring

This section details the additional electrical panel sizing and wiring required for all-electric measures. In an all-electric new construction scenario, heat pumps replace packaged DX units which are paired with either a gas furnace or a hot water coil (supplied by a gas boiler). The electrical requirements of the replacement heat pump would be the same as the packaged DX unit it replaces, as the electrical requirements would be driven by the cooling capacity, which would remain the same between the two units.

VAV terminal units with hot water reheat coils that are replaced with electric resistance reheat coils require additional electrical infrastructure. In the case of electric resistance coils, the Reach Code Team assumed that on average, a VAV terminal unit serves around 900 ft^2 of conditioned space and has a heating capacity of 5 kW (15 kBtu/hr/ft^2). The incremental electrical infrastructure costs were determined based on RS Means. Calculations for the medium office shown in Figure 13 include the cost to add electrical panels as well as the cost to add electrical lines to each VAV terminal unit electric resistance coil in the medium office prototype. Additionally, the Reach Code Team subtracted the electrical infrastructure costs associated with hot water pumps required in the mixed fuel baseline, which are not required in the all-electric measures.

The Reach Code Team calculated costs to increase electrical capacity for heat pump water heaters in the small hotel similarly.

Figure 13. Medium Office Electrical Infrastructure Costs for All-Electric Design

A	-	No. VAV Boxes	60
B	-	VAV box heating capacity (watts)	4,748
C	-	No. hot water pumps	2
D	-	Hot water pump power (watts)	398
E	-	Voltage	208
F	(AxB - CxD)/E	Panel ampacity required	1,366
G	F/400	Number of 400-amp panels required	4
H	-	Cost per 400-amp panel	$3,100
I	GxH	Total panel cost	$12,400
J	-	Total electrical line length required (ft)	4,320
K	-	Cost per linear foot of electrical line	$3.62
L	JxK	Total electrical line cost	$15,402
	I + L	**Total electrical infrastructure incremental cost**	**$27,802**

3.3.2.2 Natural Gas

This analysis assumes that in an all-electric new construction scenario natural gas would not be supplied to the site. 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. In the medium office prototype, natural gas piping is routed to the boiler. The Reach Code Team assumed that the boiler is on the first floor, and that 30 feet of piping is required from the connection to the main to the boiler. The Reach Code Team assumed 1” corrugated stainless steel tubing (CSST) material is used for the plumbing distribution. The Reach Code Team included costs for a natural gas plan review, service extension, and a gas meter, as shown in Figure 14 below. The natural gas plan review cost is based on information received from the City of Palo Alto Utilities. The meter costs are from PG&E and include both material and labor. The service extension costs are based on guidance from PG&E, who noted that the cost range is highly varied and that there is no “typical” cost, with costs being highly dependent on length of extension, terrain, whether the building is in a developed or undeveloped area, and number of buildings to be served. While an actual service extension cost is highly uncertain, the team believes the costs assumed in this analysis are within a reasonable range based on a sample range of costs provided by PG&E. These costs assume development in a previously developed area.

Figure 14. Natural Gas Infrastructure Cost Savings for All-Electric Prototypes

Cost Type	Medium Office	Medium Retail	Small Hotel
Natural Gas Plan Review	$2,316	$2,316	$2,316
Service Extension	$13,000	$13,000	$13,000
Meter	$3,000	$3,000	$3,000
Plumbing Distribution	$633	$9,711	$37,704
Total Cost	**$18,949**	**$28,027**	**$56,020**

3.4 *Preempted High Efficiency Appliances*

The Reach Code Team developed a package of high efficiency (HE) space and water heating appliances based on commonly available products for both the mixed-fuel and all-electric scenarios. This package assesses the standalone contribution that high efficiency measures would make toward achieving high performance thresholds. The Reach Code Team reviewed the Air Conditioning, Heating, and Refrigeration Institute (AHRI) certified product database to estimate appropriate efficiencies.[20]

The Reach Code Team determined the efficiency increases to be appropriate based on equipment type, summarized in Figure 15, with cost premiums attained from a Bay Area mechanical contractor. The ranges in efficiency are indicative of varying federal standard requirements based on equipment size.

Figure 15. High Efficiency Appliance Assumptions

	Federal Minimum Efficiency	Preempted Efficiency	Cost Premium for HE Appliance
Gas space heating and water heating	80-82%	90-95%	10-15%
Large packaged rooftop cooling	9.8-12 EER 11.4-12.9 IEER	10.5-13 EER 15-15.5 IEER	10-15%
Single zone heat pump space heating	7.7 HSPF 3.2 COP	10 HSPF 3.5 COP	6-15%
Heat pump water heating	2.0 UEF	3.3 UEF	None (market does not carry 2.0 UEF)

3.5 *Greenhouse Gas Emissions*

The analysis uses the greenhouse gas (GHG) emissions estimates from Zero Code reports available in CBECC-Com.[21] Zero Code uses 8760 hourly multipliers accounting for time dependent energy use and carbon emissions based on source emissions, including renewable portfolio standard projections. Fugitive

[20] Available at: https://www.ahridirectory.org/Search/SearchHome?ReturnUrl=%2f

[21] More information available at: https://zero-code.org/wp-content/uploads/2018/11/ZERO-Code-TSD-California.pdf

emissions are not included. There are two strings of multipliers – one for Northern California climate zones, and another for Southern California climate zones.[22]

4 Results

The Reach Code Team evaluated cost effectiveness of the following measure packages over a 2019 mixed-fuel code compliant baseline for all climate zones, as detailed in Sections 4.1 -- 4.3 and reiterated in Figure 16:

- **Package 1A – Mixed-Fuel + EE:** Mixed-fuel design with energy efficiency measures and federal minimum appliance efficiencies.
- **Package 1B – Mixed-Fuel + EE + PV + B**: Same as Package 1A, plus solar PV and batteries.
- **Package 1C – Mixed-fuel + HE**: Alternative design with high efficiency appliances, triggering federal preemption.
- **Package 2 – All-Electric Federal Code-Minimum Reference**: All-electric design with federal code minimum appliance efficiency. No solar PV or battery.
- **Package 3A – All-Electric + EE**: All-electric design with energy efficiency measures and federal minimum appliance efficiencies.
- **Package 3B – All-Electric + EE + PV + B**: Same as Package 3A, plus solar PV and batteries.
- **Package 3C – All-Electric + HE**: All-electric design with high efficiency appliances, triggering federal preemption.

Figure 16. Package Summary

Package	Fuel Type		Energy Efficiency Measures	PV & Battery (PV + B)	High Efficiency Appliances (HE)
	Mixed Fuel	All-Electric			
Mixed-Fuel Code Minimum Baseline	X				
1A – Mixed-Fuel + EE	X		X		
1B – Mixed-Fuel + EE + PV + B	X		X	X	
1C – Mixed-fuel + HE	X				X
2 – All-Electric Federal Code-Minimum Reference		X			
3A – All-Electric + EE		X	X		
3B – All-Electric + EE + PV + B		X	X	X	
3C – All-Electric + HE		X			X

[22] CBECC-Com documentation does not state which climate zones fall under which region. CBECC-Res multipliers are the same for CZs 1-5 and 11-13 (presumed to be Northern California), while there is another set of multipliers for CZs 6-10 and 14-16 (assumed to be Southern California).

Section 4.4 presents the results of the PV-only and PV+Battery analysis.

The TDV and on-bill based cost effectiveness results are presented in terms of B/C ratio and NPV in this section. What constitutes a 'benefit' or a 'cost' varies with the scenarios because both energy savings and incremental construction costs may be negative depending on the package. Typically, utility bill savings are categorized as a 'benefit' while incremental construction costs are treated as 'costs.' In cases where both construction costs are negative and utility bill savings are negative, the construction cost savings are treated as the 'benefit' while the utility bill negative savings are as the 'cost.'

Overarching factors to keep in mind when reviewing the results include:

- To pass the Energy Commission's application process, local reach codes must both be cost effective and exceed the energy performance budget using TDV (i.e., have a positive compliance margin). To emphasize these two important factors, the figures in this Section highlight in green the modeling results that have **either** a positive compliance margin or are cost effective. This will allow readers to identify whether a scenario is fully or partially supportive of a reach code, and the opportunities/challenges that the scenario presents. Conversely, Section 4.4 only highlights results that **both** have a positive compliance margin and are cost effective, to allow readers to identify reach code-ready scenarios.
    - **Note:** Compliance margin represents the proportion of energy usage that is saved compared to the baseline, measured on a TDV basis.
- The Energy Commission does not currently allow compliance credit for either solar PV or battery storage. Thus, the compliance margins in Packages 1A are the same as 1B, and Package 3A is the same as 3B. However, The Reach Code Team did include the impact of solar PV and battery when calculating TDV cost-effectiveness.
- When performance modeling residential buildings, the Energy Commission allows the Standard Design to be electric if the Proposed Design is electric, which removes TDV-related penalties and associated negative compliance margins. This essentially allows for a compliance pathway for all-electric residential buildings. Nonresidential buildings are not treated in the same way and are compared to a mixed-fuel standard design.
- Results do not include an analysis and comparison of utility rates. As mentioned in *Section 2.2*, The Reach Code Team coordinated with utilities to select tariffs for each prototype given the annual energy demand profile 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. Note that most utility time-of-use rates are continuously updated, which can affect cost effectiveness results.
- As a point of comparison, mixed-fuel baseline energy figures are provided in *Appendix 6.5*.

4.1 Cost Effectiveness Results – Medium Office

Figure 17 through Figure 23 contain the cost-effectiveness findings for the Medium Office packages. Notable findings for each package include:

- **1A – Mixed-Fuel + EE:** Packages achieve +12 to +20 percent compliance margins depending on climate zone. All packages are cost effective in all climate zones using the TDV approach. All packages are cost effective using the On-Bill approach except for LADWP territory.

- **1B – Mixed-Fuel + EE + PV + B:** All packages are cost effective using the On-Bill and TDV approaches, except On-Bill in LADWP territory. When compared to 1A, the B/C ratio changes depending on the utility and climate zone (some increase while others decrease). However, NPV savings are increased across the board, suggesting that larger investments yield larger returns.
- **1C – Mixed-Fuel + HE:** Packages achieve +3 to +5 percent compliance margins depending on climate zone, but no packages were cost effective. The incremental costs of a high efficiency condensing boiler compared to a non-condensing boiler contributes to 26-47% of total incremental cost depending on boiler size. Benefits of condensing boiler efficiency come from resetting hot water return temperature as boiler efficiency increases at lower hot water temperature. However, hot water temperature reset control cannot currently be implemented in the software. In addition, the natural gas energy cost constitutes no more than 5% of total cost for 15 climate zones, so improving boiler efficiency has limited contribution to reduction of total energy cost.
- **2 – All-Electric Federal Code-Minimum Reference:**
  - Packages achieve between -27 percent and +1 percent compliance margins depending on climate zone. This is likely because the modeled system is electric resistance, and TDV values electricity consumption more heavily than natural gas. This all-electric design without other efficiency measures does not comply with the Energy Commission's TDV performance budget.
  - All incremental costs are negative due to the elimination of natural gas infrastructure.
  - Packages achieve utility cost savings and are cost effective using the On-Bill approach in CZs 6-10 and 14-15. Packages do not achieve savings and are not cost effective using the On-Bill approach in most of PG&E territory (CZs 1,2,4, 11-13, and 16). Packages achieve savings and are cost effective using TDV in all climate zones except CZ16.
- **3A – All-Electric + EE:** Packages achieve positive compliance margins except -15 percent in CZ16, which has a higher space heating load than other climate zones. All packages are cost effective in all climate zones except CZ16.
- **3B – All-Electric + EE + PV + B:** Packages achieve positive compliance margins except -15 percent in CZ16. All packages are cost-effective from a TDV perspective in all climate zones. All packages are cost effective from an On-Bill perspective in all climate zones except in CZ 2 and CZ 16 in LADWP territory.
- **3C – All-Electric + HE:** Packages achieve between -26 percent and +2 percent compliance margins depending on climate zone. The only packages that are cost effective and with a positive compliance margin are in CZs 7-9 and 15. As described in Package 1C results, space heating is a relatively low proportion of energy costs in most climate zones, limiting the costs gains for higher efficiency equipment.

Figure 17. Cost Effectiveness for Medium Office Package 1A – Mixed-Fuel + EE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reduc-tions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 1A: Mixed Fuel + EE												
CZ01	PG&E	34,421	-808	4.5	18%	$66,649	$125,902	$71,307	1.9	1.1	$59,253	$4,658
CZ02	PG&E	40,985	-505	8.1	17%	$66,649	$163,655	$99,181	2.5	1.5	$97,005	$32,532
CZ03	PG&E	36,266	-463	7.0	20%	$66,649	$141,897	$84,051	2.1	1.3	$75,248	$17,401
CZ04	PG&E	40,590	-547	7.7	14%	$66,649	$162,139	$95,410	2.4	1.4	$95,489	$28,761
CZ04-2	CPAU	40,590	-547	7.7	14%	$66,649	$85,537	$95,410	1.3	1.4	$18,887	$28,761
CZ05	PG&E	38,888	-499	7.4	18%	$66,649	$154,044	$91,115	2.3	1.4	$87,395	$24,465
CZ05-2	SCG	38,888	-499	7.4	18%	$66,649	$156,315	$91,115	2.3	1.4	$89,665	$24,465
CZ06	SCE	39,579	-305	8.7	20%	$66,649	$86,390	$100,469	1.3	1.5	$19,741	$33,820
CZ06-2	LADWP	39,579	-305	8.7	20%	$66,649	$51,828	$100,469	0.8	1.5	($14,821)	$33,820
CZ07	SDG&E	41,817	-6	11.3	20%	$66,649	$204,394	$112,497	3.1	1.7	$137,745	$45,848
CZ08	SCE	41,637	-60	10.8	18%	$66,649	$89,783	$113,786	1.3	1.7	$23,134	$47,137
CZ08-2	LADWP	41,637	-60	10.8	18%	$66,649	$54,876	$113,786	0.8	1.7	($11,773)	$47,137
CZ09	SCE	42,539	-210	10.1	16%	$66,649	$95,636	$115,647	1.4	1.7	$28,987	$48,998
CZ09-2	LADWP	42,539	-210	10.1	16%	$66,649	$58,168	$115,647	0.9	1.7	($8,481)	$48,998
CZ10	SDG&E	41,857	-216	9.8	17%	$66,649	$210,303	$108,726	3.2	1.6	$143,654	$42,077
CZ10-2	SCE	41,857	-216	9.8	17%	$66,649	$92,736	$108,726	1.4	1.6	$26,087	$42,077
CZ11	PG&E	42,523	-390	9.1	13%	$66,649	$166,951	$104,001	2.5	1.6	$100,301	$37,352
CZ12	PG&E	41,521	-466	8.4	14%	$66,649	$161,594	$100,135	2.4	1.5	$94,945	$33,486
CZ12-2	SMUD	41,521	-466	8.4	14%	$66,649	$71,734	$100,135	1.1	1.5	$5,085	$33,486
CZ13	PG&E	42,898	-434	9.0	13%	$66,649	$169,107	$99,992	2.5	1.5	$102,457	$33,343
CZ14	SDG&E	42,224	-441	8.6	14%	$66,649	$211,529	$106,913	3.2	1.6	$144,880	$40,264
CZ14-2	SCE	42,224	-441	8.6	14%	$66,649	$95,809	$106,913	1.4	1.6	$29,160	$40,264
CZ15	SCE	45,723	-147	11.2	12%	$66,649	$102,714	$118,034	1.5	1.8	$36,065	$51,384
CZ16	PG&E	37,758	-736	5.8	14%	$66,649	$145,947	$79,755	2.2	1.2	$79,297	$13,106
CZ16-2	LADWP	37,758	-736	5.8	14%	$66,649	$40,115	$79,755	0.6	1.2	($26,534)	$13,106

Figure 18. Cost Effectiveness for Medium Office Package 1B – Mixed-Fuel + EE + PV + B

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (mtons)	Comp-liance Margin (%)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + PV + Battery												
CZ01	PG&E	211,225	-808	39.9	18%	$397,405	$645,010	$454,284	1.6	1.1	$247,605	$56,879
CZ02	PG&E	255,787	-505	50.6	17%	$397,405	$819,307	$573,033	2.1	1.4	$421,902	$175,628
CZ03	PG&E	245,421	-463	48.8	20%	$397,405	$777,156	$536,330	2.0	1.3	$379,751	$138,925
CZ04	PG&E	267,612	-547	52.7	14%	$397,405	$836,221	$597,471	2.1	1.5	$438,816	$200,066
CZ04-2	CPAU	267,612	-547	52.7	14%	$397,405	$621,879	$597,471	1.6	1.5	$224,474	$200,066
CZ05	PG&E	264,581	-499	52.5	18%	$397,405	$897,216	$578,856	2.3	1.5	$499,811	$181,451
CZ05-2	SCG	264,581	-499	52.5	18%	$397,405	$899,487	$578,856	2.3	1.5	$502,082	$181,451
CZ06	SCE	257,474	-305	52.1	20%	$397,405	$484,229	$594,416	1.2	1.5	$86,824	$197,011
CZ06-2	LA	257,474	-305	52.1	20%	$397,405	$282,360	$594,416	0.7	1.5	($115,045)	$197,011
CZ07	SDG&E	264,530	-6	55.7	20%	$397,405	$817,528	$610,548	2.1	1.5	$420,123	$213,143
CZ08	SCE	258,348	-60	54.0	18%	$397,405	$479,073	$625,249	1.2	1.6	$81,668	$227,844
CZ08-2	LA	258,348	-60	54.0	18%	$397,405	$275,704	$625,249	0.7	1.6	($121,701)	$227,844
CZ09	SCE	262,085	-210	54.3	16%	$397,405	$480,241	$622,528	1.2	1.6	$82,836	$225,123
CZ09-2	LA	262,085	-210	54.3	16%	$397,405	$282,209	$622,528	0.7	1.6	($115,196)	$225,123
CZ10	SDG&E	258,548	-216	53.4	17%	$397,405	$839,931	$595,323	2.1	1.5	$442,526	$197,918
CZ10-2	SCE	258,548	-216	53.4	17%	$397,405	$485,523	$595,323	1.2	1.5	$88,118	$197,918
CZ11	PG&E	253,623	-390	50.9	13%	$397,405	$826,076	$585,682	2.1	1.5	$428,671	$188,277
CZ12	PG&E	252,868	-466	50.3	14%	$397,405	$802,715	$582,866	2.0	1.5	$405,310	$185,461
CZ12-2	SMUD	252,868	-466	50.3	14%	$397,405	$415,597	$582,866	1.0	1.5	$18,192	$185,461
CZ13	PG&E	250,915	-434	50.4	13%	$397,405	$806,401	$573,606	2.0	1.4	$408,996	$176,201
CZ14	SDG&E	283,684	-441	56.4	14%	$397,405	$874,753	$676,271	2.2	1.7	$477,348	$278,866
CZ14-2	SCE	283,684	-441	56.4	14%	$397,405	$493,888	$676,271	1.2	1.7	$96,483	$278,866
CZ15	SCE	274,771	-147	56.0	12%	$397,405	$476,327	$640,379	1.2	1.6	$78,922	$242,974
CZ16	PG&E	266,490	-736	51.8	14%	$397,405	$842,205	$575,563	2.1	1.4	$444,800	$178,158
CZ16-2	LA	266,490	-736	51.8	14%	$397,405	$260,372	$575,563	0.7	1.4	($137,033)	$178,158

Figure 19. Cost Effectiveness for Medium Office Package 1C – Mixed-Fuel + HE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 1C: Mixed Fuel + HE												
CZ01	PG&E	288	688	4.1	3%	$61,253	$18,656	$12,314	0.3	0.2	($42,597)	($48,939)
CZ02	PG&E	3,795	550	4.3	4%	$68,937	$36,683	$24,676	0.5	0.4	($32,254)	($44,261)
CZ03	PG&E	1,241	439	2.9	3%	$57,529	$20,150	$11,885	0.4	0.2	($37,379)	($45,644)
CZ04	PG&E	5,599	529	4.7	5%	$72,074	$44,915	$30,928	0.6	0.4	($27,158)	($41,145)
CZ04-2	CPAU	5,599	529	4.7	5%	$72,074	$24,175	$30,928	0.3	0.4	($47,898)	($41,145)
CZ05	PG&E	3,470	453	3.6	4%	$60,330	$35,072	$18,232	0.6	0.3	($25,258)	($42,097)
CZ05-2	SCG	3,470	453	3.6	4%	$60,330	$32,777	$18,232	0.5	0.3	($27,553)	($42,097)
CZ06	SCE	3,374	298	2.6	3%	$55,594	$19,446	$16,132	0.3	0.3	($36,148)	($39,462)
CZ06-2	LADWP	3,374	298	2.6	3%	$55,594	$13,450	$16,132	0.2	0.3	($42,145)	($39,462)
CZ07	SDG&E	5,257	140	2.3	4%	$54,111	$41,086	$19,903	0.8	0.4	($13,025)	($34,208)
CZ08	SCE	5,921	176	2.7	4%	$60,497	$22,210	$24,055	0.4	0.4	($38,287)	($36,442)
CZ08-2	LADWP	5,921	176	2.7	4%	$60,497	$14,064	$24,055	0.2	0.4	($46,434)	($36,442)
CZ09	SCE	7,560	224	3.5	4%	$61,311	$28,576	$31,835	0.5	0.5	($32,735)	($29,476)
CZ09-2	LADWP	7,560	224	3.5	4%	$61,311	$18,262	$31,835	0.3	0.5	($43,049)	($29,476)
CZ10	SDG&E	5,786	288	3.2	4%	$62,685	$50,717	$24,628	0.8	0.4	($11,968)	($38,057)
CZ10-2	SCE	5,786	288	3.2	4%	$62,685	$24,575	$24,628	0.4	0.4	($38,110)	($38,057)
CZ11	PG&E	8,128	441	4.9	5%	$71,101	$54,188	$37,849	0.8	0.5	($16,912)	($33,252)
CZ12	PG&E	6,503	478	4.7	5%	$68,329	$47,329	$34,556	0.7	0.5	($20,999)	($33,773)
CZ12-2	SMUD	6,503	478	4.7	5%	$68,329	$24,003	$34,556	0.4	0.5	($44,325)	($33,773)
CZ13	PG&E	8,398	432	5.0	5%	$69,474	$51,347	$37,229	0.7	0.5	($18,128)	($32,246)
CZ14	SDG&E	7,927	470	5.0	5%	$69,463	$62,744	$37,133	0.9	0.5	($6,718)	($32,329)
CZ14-2	SCE	7,927	470	5.0	5%	$69,463	$32,517	$37,133	0.5	0.5	($36,946)	($32,329)
CZ15	SCE	15,140	219	5.5	5%	$66,702	$43,773	$52,359	0.7	0.8	($22,929)	($14,344)
CZ16	PG&E	3,111	912	6.3	5%	$71,765	$36,002	$24,914	0.5	0.3	($35,763)	($46,851)
CZ16-2	LADWP	3,111	912	6.3	5%	$71,765	$23,057	$24,914	0.3	0.3	($48,708)	($46,851)

Figure 20. Cost Effectiveness for Medium Office Package 2 – All-Electric Federal Code Minimum

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost*	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 2: All-Electric Federal Code Minimum												
CZ01	PG&E	-53,657	4967	10.1	-15%	($87,253)	($98,237)	($58,420)	0.9	1.5	($10,984)	$28,833
CZ02	PG&E	-49,684	3868	5.0	-7%	($73,695)	($101,605)	($41,429)	0.7	1.8	($27,910)	$32,266
CZ03	PG&E	-35,886	3142	5.6	-7%	($82,330)	($57,345)	($29,592)	1.4	2.8	$24,986	$52,738
CZ04	PG&E	-48,829	3759	4.7	-6%	($69,012)	($90,527)	($40,570)	0.8	1.7	($21,515)	$28,443
CZ04-2	CPAU	-48,829	3759	4.7	-6%	($69,012)	($19,995)	($40,570)	3.5	1.7	$49,018	$28,443
CZ05	PG&E	-40,531	3240	4.5	-8%	($84,503)	($63,663)	($39,997)	1.3	2.1	$20,840	$44,506
CZ06	SCE	-26,174	2117	3.1	-4%	($76,153)	$24,908	($20,571)	>1	3.7	$101,061	$55,581
CZ06-2	LADWP	-26,174	2117	3.1	-4%	($76,153)	$26,366	($20,571)	>1	3.7	$102,518	$55,581
CZ07	SDG&E	-12,902	950	0.9	-2%	($70,325)	$46,879	($11,407)	>1	6.2	$117,204	$58,918
CZ08	SCE	-15,680	1219	1.5	-2%	($68,774)	$17,859	($12,648)	>1	5.4	$86,633	$56,125
CZ08-2	LADWP	-15,680	1219	1.5	-2%	($68,774)	$18,603	($12,648)	>1	5.4	$87,376	$56,125
CZ09	SCE	-19,767	1605	2.4	-2%	($63,102)	$20,920	($14,462)	>1	4.4	$84,022	$48,640
CZ09-2	LADWP	-19,767	1605	2.4	-2%	($63,102)	$21,929	($14,462)	>1	4.4	$85,030	$48,640
CZ10	SDG&E	-27,414	2053	2.2	-4%	($47,902)	$38,918	($23,339)	>1	2.1	$86,820	$24,562
CZ10-2	SCE	-27,414	2053	2.2	-4%	($47,902)	$20,765	($23,339)	>1	2.1	$68,666	$24,562
CZ11	PG&E	-40,156	3062	3.6	-4%	($63,987)	($72,791)	($32,837)	0.9	1.9	($8,804)	$31,150
CZ12	PG&E	-43,411	3327	4.1	-5%	($68,343)	($85,856)	($35,463)	0.8	1.9	($17,512)	$32,880
CZ12-2	SMUD	-43,411	3327	4.1	-5%	($68,343)	($5,109)	($35,463)	13.4	1.9	$63,234	$32,880
CZ13	PG&E	-39,649	3063	3.8	-4%	($62,726)	($70,705)	($32,408)	0.9	1.9	($7,980)	$30,318
CZ14	SDG&E	-44,322	3266	3.4	-5%	($65,156)	$6,043	($38,422)	>1	1.7	$71,199	$26,735
CZ14-2	SCE	-44,322	3266	3.4	-5%	($65,156)	$4,798	($38,422)	>1	1.7	$69,954	$26,735
CZ15	SCE	-19,917	1537	1.8	-2%	($36,176)	$12,822	($15,464)	>1	2.3	$48,998	$20,711
CZ16	PG&E	-94,062	6185	5.6	-27%	($64,096)	($212,158)	($150,871)	0.3	0.4	($148,062)	($86,775)
CZ16-2	LADWP	-94,062	6185	5.6	-27%	($64,096)	$1,493	($150,871)	>1	0.4	$65,589	($86,775)

* The Incremental Package Cost is equal to the sum of the incremental HVAC and water heating equipment costs from

Figure 10, the electrical infrastructure incremental cost of $27,802 (see section 3.3.2.1), and the natural gas infrastructure incremental costs of $(18,949) (see section 3.3.2.2).

Figure 21. Cost Effectiveness for Medium Office Package 3A – All-Electric + EE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 3A: All-Electric + EE												
CZ01	PG&E	-19,115	4967	19.4	7%	($20,604)	$20,630	$28,112	>1	>1	$41,234	$48,716
CZ02	PG&E	-11,811	3868	15.2	10%	($7,046)	$39,260	$58,563	>1	>1	$46,306	$65,609
CZ03	PG&E	2,530	3142	16.2	16%	($15,681)	$85,241	$68,682	>1	>1	$100,922	$84,363
CZ04	PG&E	-10,839	3759	14.8	9%	($2,363)	$59,432	$58,420	>1	>1	$61,795	$60,783
CZ04-2	CPAU	-10,839	3759	14.8	9%	($2,363)	$70,680	$58,420	>1	>1	$73,043	$60,783
CZ05	PG&E	-2,316	3240	14.6	12%	($17,854)	$85,380	$58,802	>1	>1	$103,234	$76,656
CZ06	SCE	15,399	2117	14.3	18%	($9,503)	$114,962	$89,921	>1	>1	$124,466	$99,425
CZ06-2	LADWP	15,399	2117	14.3	18%	($9,503)	$82,389	$89,921	>1	>1	$91,893	$99,425
CZ07	SDG&E	33,318	950	13.8	20%	($3,676)	$256,704	$111,399	>1	>1	$260,380	$115,076
CZ08	SCE	30,231	1219	14.2	18%	($2,124)	$110,144	$111,781	>1	>1	$112,268	$113,906
CZ08-2	LADWP	30,231	1219	14.2	18%	($2,124)	$76,069	$111,781	>1	>1	$78,194	$113,906
CZ09	SCE	24,283	1605	14.3	15%	$3,547	$119,824	$108,249	33.8	30.5	$116,277	$104,702
CZ09-2	LADWP	24,283	1605	14.3	15%	$3,547	$83,549	$108,249	23.6	30.5	$80,001	$104,702
CZ10	SDG&E	12,344	2053	12.6	13%	$18,748	$230,553	$82,905	12.3	4.4	$211,806	$64,158
CZ10-2	SCE	12,344	2053	12.6	13%	$18,748	$105,898	$82,905	5.6	4.4	$87,150	$64,158
CZ11	PG&E	929	3062	14.5	10%	$2,662	$85,988	$75,030	32.3	28.2	$83,326	$72,368
CZ12	PG&E	-3,419	3327	14.8	10%	($1,694)	$68,866	$69,589	>1	>1	$70,560	$71,283
CZ12-2	SMUD	-3,419	3327	14.8	10%	($1,694)	$71,761	$69,589	>1	>1	$73,455	$71,283
CZ13	PG&E	1,398	3063	14.8	9%	$3,923	$89,799	$71,307	22.9	18.2	$85,875	$67,384
CZ14	SDG&E	-5,469	3266	13.5	9%	$1,493	$206,840	$69,016	138.6	46.2	$205,347	$67,523
CZ14-2	SCE	-5,469	3266	13.5	9%	$1,493	$94,143	$69,016	63.1	46.2	$92,650	$67,523
CZ15	SCE	25,375	1537	13.7	10%	$30,474	$114,909	$104,335	3.8	3.4	$84,435	$73,862
CZ16	PG&E	-65,877	6185	12.7	-15%	$2,553	($91,477)	($85,673)	-35.8	-33.6	($94,030)	($88,226)
CZ16-2	LADWP	-65,877	6185	12.7	-15%	$2,553	$72,780	($85,673)	28.5	-33.6	$70,227	($88,226)

Figure 22. Cost Effectiveness for Medium Office Package 3B – All-Electric + EE + PV + B

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (mtons)	Compliance Margin (%)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + PV + B												
CZ01	PG&E	157,733	4967	54.9	7%	$310,152	$518,421	$410,946	1.7	1.3	$208,269	$100,794
CZ02	PG&E	203,026	3868	57.8	10%	$323,710	$692,336	$532,273	2.1	1.6	$368,626	$208,563
CZ03	PG&E	211,706	3142	58.0	16%	$315,075	$708,235	$520,866	2.2	1.7	$393,160	$205,791
CZ04	PG&E	216,204	3759	59.9	9%	$328,393	$741,382	$560,576	2.3	1.7	$412,989	$232,183
CZ04-2	CPAU	216,204	3759	59.9	9%	$328,393	$607,074	$560,576	1.8	1.7	$278,681	$232,183
CZ05	PG&E	223,399	3240	59.8	12%	$312,902	$799,992	$546,592	2.6	1.7	$487,090	$233,690
CZ06	SCE	233,299	2117	57.7	18%	$321,252	$509,969	$583,963	1.6	1.8	$188,716	$262,711
CZ06-2	LA	233,299	2117	57.7	18%	$321,252	$311,931	$583,963	1.0	1.8	($9,322)	$262,711
CZ07	SDG&E	256,034	950	58.3	20%	$327,079	$870,156	$609,498	2.7	1.9	$543,076	$282,419
CZ08	SCE	246,944	1219	57.4	18%	$328,631	$499,506	$623,292	1.5	1.9	$170,874	$294,661
CZ08-2	LA	246,944	1219	57.4	18%	$328,631	$296,991	$623,292	0.9	1.9	($31,640)	$294,661
CZ09	SCE	243,838	1605	58.5	15%	$334,303	$504,498	$615,178	1.5	1.8	$170,195	$280,875
CZ09-2	LA	243,838	1605	58.5	15%	$334,303	$307,626	$615,178	0.9	1.8	($26,677)	$280,875
CZ10	SDG&E	229,044	2053	56.2	13%	$349,503	$851,810	$569,549	2.4	1.6	$502,306	$220,046
CZ10-2	SCE	229,044	2053	56.2	13%	$349,503	$491,383	$569,549	1.4	1.6	$141,880	$220,046
CZ11	PG&E	212,047	3062	56.4	10%	$333,418	$743,403	$556,758	2.2	1.7	$409,985	$223,340
CZ12	PG&E	207,955	3327	56.7	10%	$329,062	$713,054	$552,415	2.2	1.7	$383,993	$223,353
CZ12-2	SMUD	207,955	3327	56.7	10%	$329,062	$414,371	$552,415	1.3	1.7	$85,310	$223,353
CZ13	PG&E	209,431	3063	56.3	9%	$334,679	$728,822	$544,969	2.2	1.6	$394,143	$210,289
CZ14	SDG&E	236,002	3266	61.3	9%	$332,249	$865,181	$638,517	2.6	1.9	$532,933	$306,269
CZ14-2	SCE	236,002	3266	61.3	9%	$332,249	$488,163	$638,517	1.5	1.9	$155,914	$306,269
CZ15	SCE	254,426	1537	58.5	10%	$361,229	$487,715	$626,728	1.4	1.7	$126,486	$265,499
CZ16	PG&E	162,915	6185	58.6	-15%	$333,309	$580,353	$406,746	1.7	1.2	$247,044	$73,437
CZ16-2	LA	162,915	6185	58.6	-15%	$333,309	$290,566	$406,746	0.9	1.2	($42,742)	$73,437

Figure 23. Cost Effectiveness for Medium Office Package 3C – All-Electric + HE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 3C: All-Electric + HE												
CZ01	PG&E	-53,390	4967	10.2	-14%	($43,987)	($93,740)	($57,752)	0.5	0.8	($49,753)	($13,765)
CZ02	PG&E	-45,916	3868	6.1	-5%	($22,722)	($77,212)	($26,394)	0.3	0.9	($54,490)	($3,672)
CZ03	PG&E	-34,656	3142	6.0	-6%	($38,261)	($45,796)	($25,153)	0.8	1.5	($7,535)	$13,108
CZ04	PG&E	-43,248	3759	6.3	-3%	($15,229)	($56,932)	($18,996)	0.3	0.8	($41,703)	($3,767)
CZ04-2	CPAU	-43,248	3759	6.3	-3%	($15,229)	($5,298)	($18,996)	2.9	0.8	$9,932	($3,767)
CZ05	PG&E	-37,068	3240	5.4	-6%	($40,434)	($38,330)	($29,544)	1.1	1.4	$2,104	$10,890
CZ06	SCE	-22,805	2117	4.0	-2%	($30,237)	$39,812	($9,594)	>1	3.2	$70,050	$20,644
CZ06-2	LADWP	-22,805	2117	4.0	-2%	($30,237)	$35,414	($9,594)	>1	3.2	$65,651	$20,644
CZ07	SDG&E	-7,646	950	2.5	1%	($22,564)	$86,159	$6,062	>1	>1	$108,722	$28,625
CZ08	SCE	-9,761	1219	3.2	1%	($18,443)	$37,375	$8,305	>1	>1	$55,818	$26,748
CZ08-2	LADWP	-9,761	1219	3.2	1%	($18,443)	$29,973	$8,305	>1	>1	$48,416	$26,748
CZ09	SCE	-12,211	1605	4.5	2%	($10,282)	$46,335	$13,364	>1	>1	$56,617	$23,646
CZ09-2	LADWP	-12,211	1605	4.5	2%	($10,282)	$37,030	$13,364	>1	>1	$47,313	$23,646
CZ10	SDG&E	-21,642	2053	3.7	-1%	$11,340	$84,901	($3,818)	7.5	-0.3	$73,561	($15,158)
CZ10-2	SCE	-21,642	2053	3.7	-1%	$11,340	$40,659	($3,818)	3.6	-0.3	$29,319	($15,158)
CZ11	PG&E	-32,052	3062	5.9	0%	($8,519)	($29,013)	($3,007)	0.3	2.8	($20,495)	$5,512
CZ12	PG&E	-36,926	3327	6.0	-1%	($15,443)	($48,955)	($9,546)	0.3	1.6	($33,511)	$5,898
CZ12-2	SMUD	-36,926	3327	6.0	-1%	($15,443)	$9,916	($9,546)	>1	1.6	$25,359	$5,898
CZ13	PG&E	-31,253	3063	6.3	0%	($7,257)	($27,782)	($3,055)	0.3	2.4	($20,525)	$4,202
CZ14	SDG&E	-36,402	3266	5.7	-1%	($10,651)	$61,605	($9,832)	>1	1.1	$72,256	$819
CZ14-2	SCE	-36,402	3266	5.7	-1%	($10,651)	$30,625	($9,832)	>1	1.1	$41,276	$819
CZ15	SCE	-4,775	1537	6.0	3%	$28,927	$52,955	$32,790	1.8	1.1	$24,028	$3,863
CZ16	PG&E	-90,949	6185	6.5	-26%	($8,467)	($194,115)	($142,041)	0.0	0.1	($185,648)	($133,574)
CZ16-2	LADWP	-90,949	6185	6.5	-26%	($8,467)	$37,127	($142,041)	>1	0.1	$45,594	($133,574)

4.2 Cost Effectiveness Results – Medium Retail

Figure 24 through Figure 30 contain the cost-effectiveness findings for the Medium Retail packages. Notable findings for each package include:

- **1A – Mixed-Fuel + EE:**
  - Packages achieve +9% to +18% compliance margins depending on climate zone, and all packages are cost effective in all climate zones.
  - Incremental package costs vary across climate zones because of the HVAC system size in some climate zones are small enough (<54 kBtu/h) to have the economizers measure applied.
  - B/C ratios are high compared to other prototypes because the measures applied are primarily low-cost lighting measures. This suggests room for the inclusion of other energy efficiency measures with lower cost-effectiveness to achieve even higher compliance margins for a cost effective package.
- **1B – Mixed-Fuel + EE + PV + B:** All packages are cost effective using both the On-Bill and TDV approach, except On-Bill in LADWP territory. Adding PV and battery to the efficiency packages reduces the B/C ratio but increases overall NPV savings.
- **1C – Mixed-fuel + HE:** Packages achieve +1 to +4% compliance margins depending on climate zone, and packages are cost effective in all climate zones except CZs 1, 3 and 5 using the TDV approach.
- **2 – All-Electric Federal Code-Minimum Reference:**
  - Packages achieve between -12% and +1% compliance margins depending on climate zone.
  - Packages achieve positive savings using both the On-Bill and TDV approaches in CZs 6-10 and 14-15. Packages do not achieve On-Bill or TDV savings in most of PG&E territory (CZs 1, 2, 4, 5, 12-13, and 16).
  - Packages are cost effective in all climate zones except CZ16.
  - All incremental costs are negative primarily due to elimination of natural gas infrastructure.
- **3A – All-Electric + EE:** Packages achieve between +3% and +16% compliance margins depending on climate zone. All packages are cost effective in all climate zones.
- **3B – All-Electric + EE + PV + B:** All packages are cost effective using both the On-Bill and TDV approaches, except On-Bill in LADWP territory. Adding PV and Battery to the efficiency package reduces the B/C ratio but increases overall NPV savings.
- **3C – All-Electric + HE:** Packages achieve between -8% and +5% compliance margins depending on climate zone, and packages are cost effective using both On-Bill and TDV approaches in all CZs except CZs 1 and 16.

Figure 24. Cost Effectiveness for Medium Retail Package 1A – Mixed-Fuel + EE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 1A: Mixed Fuel + EE												
CZ01	PG&E	15,210	1209	11.10	18%	$2,712	$68,358	$60,189	25.2	22.2	$65,646	$57,478
CZ02	PG&E	18,885	613	8.73	13%	$5,569	$76,260	$59,135	13.7	10.6	$70,691	$53,566
CZ03	PG&E	18,772	462	7.87	16%	$5,569	$66,813	$57,135	12.0	10.3	$61,244	$51,566
CZ04	PG&E	19,100	439	7.84	14%	$5,569	$75,989	$58,036	13.6	10.4	$70,420	$52,467
CZ04-2	CPAU	19,100	439	7.84	14%	$5,569	$51,556	$58,036	9.3	10.4	$45,987	$52,467
CZ05	PG&E	17,955	415	7.41	16%	$5,569	$63,182	$55,003	11.3	9.9	$57,613	$49,435
CZ05-2	SCG	17,955	415	7.41	16%	$5,569	$61,810	$55,003	11.1	9.9	$56,241	$49,435
CZ06	SCE	12,375	347	5.54	10%	$2,712	$31,990	$41,401	11.8	15.3	$29,278	$38,689
CZ06-2	LADWP	12,375	347	5.54	10%	$2,712	$21,667	$41,401	8.0	15.3	$18,956	$38,689
CZ07	SDG&E	17,170	136	5.65	13%	$5,569	$73,479	$49,883	13.2	9.0	$67,910	$44,314
CZ08	SCE	12,284	283	5.15	10%	$2,712	$30,130	$41,115	11.1	15.2	$27,419	$38,403
CZ08-2	LADWP	12,284	283	5.15	10%	$2,712	$20,243	$41,115	7.5	15.2	$17,531	$38,403
CZ09	SCE	13,473	302	5.51	10%	$5,569	$32,663	$46,126	5.9	8.3	$27,094	$40,557
CZ09-2	LADWP	13,473	302	5.51	10%	$5,569	$22,435	$46,126	4.0	8.3	$16,866	$40,557
CZ10	SDG&E	19,873	267	6.99	12%	$5,569	$83,319	$58,322	15.0	10.5	$77,751	$52,753
CZ10-2	SCE	19,873	267	6.99	12%	$5,569	$39,917	$58,322	7.2	10.5	$34,348	$52,753
CZ11	PG&E	21,120	578	9.14	13%	$5,569	$86,663	$67,485	15.6	12.1	$81,095	$61,916
CZ12	PG&E	20,370	562	8.85	13%	$5,569	$81,028	$64,409	14.6	11.6	$75,459	$58,840
CZ12-2	SMUD	20,370	562	8.85	13%	$5,569	$44,991	$64,409	8.1	11.6	$39,422	$58,840
CZ13	PG&E	22,115	620	9.98	15%	$2,712	$109,484	$83,109	40.4	30.6	$106,772	$80,398
CZ14	SDG&E	25,579	406	9.38	13%	$2,712	$116,354	$80,055	42.9	29.5	$113,643	$77,343
CZ14-2	SCE	26,327	383	9.42	13%	$2,712	$57,290	$83,065	21.1	30.6	$54,578	$80,354
CZ15	SCE	26,433	169	8.35	12%	$2,712	$57,152	$79,506	21.1	29.3	$54,440	$76,794
CZ16	PG&E	15,975	752	8.72	13%	$2,712	$72,427	$55,025	26.7	20.3	$69,715	$52,314
CZ16-2	LADWP	15,975	752	8.72	13%	$2,712	$31,906	$55,025	11.8	20.3	$29,194	$52,314

Figure 25. Cost Effectiveness for Medium Retail Package 1B – Mixed-Fuel + EE + PV + B

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Compliance Margin (%)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + PV + Battery												
CZ01	PG&E	158,584	1209	40.79	18%	$277,383	$509,092	$383,683	1.8	1.4	$231,709	$106,300
CZ02	PG&E	189,400	613	43.75	13%	$280,240	$590,043	$465,474	2.1	1.7	$309,803	$185,234
CZ03	PG&E	191,016	462	43.52	16%	$280,240	$578,465	$452,795	2.1	1.6	$298,224	$172,554
CZ04	PG&E	195,014	439	44.14	14%	$280,240	$605,369	$480,989	2.2	1.7	$325,129	$200,748
CZ04-2	CPAU	195,014	439	44.14	14%	$280,240	$451,933	$480,989	1.6	1.7	$171,693	$200,748
CZ05	PG&E	196,654	415	44.30	16%	$280,240	$589,771	$464,749	2.1	1.7	$309,530	$184,509
CZ05-2	SCG	196,654	415	44.30	16%	$280,240	$588,407	$464,749	2.1	1.7	$308,167	$184,509
CZ06	SCE	185,903	347	41.61	10%	$277,383	$322,495	$456,596	1.2	1.6	$45,111	$179,213
CZ06-2	LA	185,903	347	41.61	10%	$277,383	$191,428	$456,596	0.7	1.6	($85,955)	$179,213
CZ07	SDG&E	197,650	136	43.24	13%	$280,240	$496,786	$477,582	1.8	1.7	$216,545	$197,342
CZ08	SCE	187,869	283	41.48	10%	$277,383	$326,810	$478,132	1.2	1.7	$49,427	$200,749
CZ08-2	LA	187,869	283	41.48	10%	$277,383	$190,379	$478,132	0.7	1.7	($87,004)	$200,749
CZ09	SCE	191,399	302	42.32	10%	$280,240	$334,869	$472,770	1.2	1.7	$54,629	$192,530
CZ09-2	LA	191,399	302	42.32	10%	$280,240	$201,759	$472,770	0.7	1.7	($78,481)	$192,530
CZ10	SDG&E	200,033	267	44.01	12%	$280,240	$547,741	$472,880	2.0	1.7	$267,501	$192,640
CZ10-2	SCE	200,033	267	44.01	12%	$280,240	$340,822	$472,880	1.2	1.7	$60,582	$192,640
CZ11	PG&E	192,846	578	44.07	13%	$280,240	$582,969	$490,855	2.1	1.8	$302,728	$210,615
CZ12	PG&E	191,720	562	43.70	13%	$280,240	$586,836	$485,076	2.1	1.7	$306,596	$204,836
CZ12-2	SMUD	191,720	562	43.70	13%	$280,240	$319,513	$485,076	1.1	1.7	$39,273	$204,836
CZ13	PG&E	195,031	620	45.19	15%	$277,383	$605,608	$486,285	2.2	1.8	$328,225	$208,901
CZ14	SDG&E	217,183	406	47.86	13%	$277,383	$559,148	$534,915	2.0	1.9	$281,765	$257,532
CZ14-2	SCE	217,927	383	47.91	14%	$277,383	$354,757	$538,058	1.3	1.9	$77,373	$260,674
CZ15	SCE	208,662	169	44.51	12%	$277,383	$338,772	$496,107	1.2	1.8	$61,389	$218,724
CZ16	PG&E	210,242	752	48.76	13%	$277,383	$608,779	$490,262	2.2	1.8	$331,395	$212,879
CZ16-2	LA	210,242	752	48.76	13%	$277,383	$207,160	$490,262	0.7	1.8	($70,223)	$212,879

Figure 26. Cost Effectiveness for Medium Retail Package 1C – Mixed-Fuel + HE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 1C: Mixed Fuel + HE												
CZ01	PG&E	57	346	2.04	2%	$9,006	$6,301	$6,065	0.7	0.7	($2,705)	($2,941)
CZ02	PG&E	2,288	229	2.01	3%	$9,726	$23,016	$13,998	2.4	1.4	$13,291	$4,273
CZ03	PG&E	1,087	171	1.31	2%	$9,063	$6,782	$7,186	0.7	0.8	($2,282)	($1,877)
CZ04	PG&E	1,862	159	1.46	3%	$9,004	$17,891	$10,878	2.0	1.2	$8,887	$1,874
CZ04-2	CPAU	1,862	159	1.46	3%	$9,004	$7,821	$10,878	0.9	1.2	($1,182)	$1,874
CZ05	PG&E	664	162	1.11	1%	$9,454	$5,119	$4,725	0.5	0.5	($4,335)	($4,729)
CZ05-2	SCG	664	162	1.11	1%	$9,454	$4,558	$4,725	0.5	0.5	($4,896)	($4,729)
CZ06	SCE	2,648	90	1.24	3%	$8,943	$11,646	$11,427	1.3	1.3	$2,703	$2,484
CZ06-2	LADWP	2,648	90	1.24	3%	$8,943	$7,329	$11,427	0.8	1.3	($1,614)	$2,484
CZ07	SDG&E	2,376	49	0.95	2%	$9,194	$20,103	$9,779	2.2	1.1	$10,909	$585
CZ08	SCE	2,822	72	1.20	3%	$9,645	$11,989	$12,877	1.2	1.3	$2,344	$3,233
CZ08-2	LADWP	2,822	72	1.20	3%	$9,645	$7,427	$12,877	0.8	1.3	($2,218)	$3,233
CZ09	SCE	4,206	88	1.73	4%	$10,446	$16,856	$18,745	1.6	1.8	$6,410	$8,299
CZ09-2	LADWP	4,206	88	1.73	4%	$10,446	$10,604	$18,745	1.0	1.8	$158	$8,299
CZ10	SDG&E	4,226	119	1.88	4%	$9,514	$36,412	$19,008	3.8	2.0	$26,898	$9,494
CZ10-2	SCE	4,226	119	1.88	4%	$9,514	$17,094	$19,008	1.8	2.0	$7,580	$9,494
CZ11	PG&E	4,188	225	2.56	4%	$10,479	$31,872	$22,393	3.0	2.1	$21,392	$11,913
CZ12	PG&E	3,675	214	2.34	4%	$10,409	$29,653	$20,525	2.8	2.0	$19,243	$10,115
CZ12-2	SMUD	3,675	214	2.34	4%	$10,409	$12,823	$20,525	1.2	2.0	$2,414	$10,115
CZ13	PG&E	4,818	180	2.46	4%	$9,809	$34,149	$23,623	3.5	2.4	$24,340	$13,814
CZ14	SDG&E	6,439	153	2.71	4%	$12,103	$44,705	$26,348	3.7	2.2	$32,601	$14,245
CZ14-2	SCE	6,439	153	2.71	4%	$12,103	$22,032	$26,348	1.8	2.2	$9,929	$14,245
CZ15	SCE	8,802	48	2.76	5%	$12,534	$25,706	$31,402	2.1	2.5	$13,171	$18,868
CZ16	PG&E	2,316	390	2.97	3%	$11,999	$22,663	$13,888	1.9	1.2	$10,665	$1,890
CZ16-2	LADWP	2,316	390	2.97	3%	$11,999	$11,921	$13,888	1.0	1.2	($78)	$1,890

Figure 27. Cost Effectiveness for Medium Retail Package 2 – All-Electric Federal Code Minimum

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost*	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 2: All-Electric Federal Code Minimum												
CZ01	PG&E	-29,155	3893	13.85	-4.1%	($23,048)	($8,333)	($13,910)	2.8	1.7	$14,715	$9,138
CZ02	PG&E	-21,786	2448	7.49	-1.0%	($27,464)	($16,476)	($4,483)	1.7	6.1	$10,987	$22,981
CZ03	PG&E	-14,583	1868	6.26	-0.4%	($24,111)	$263	($1,450)	>1	16.6	$24,374	$22,661
CZ04	PG&E	-14,186	1706	5.30	-0.1%	($22,896)	($8,753)	($220)	2.6	104.2	$14,143	$22,676
CZ04-2	CPAU	-14,186	1706	5.30	-0.1%	($22,896)	$12,493	($220)	>1	104.2	$35,389	$22,676
CZ05	PG&E	-14,334	1746	5.47	-1.2%	($25,507)	($1,567)	($4,197)	16.3	6.1	$23,940	$21,309
CZ06	SCE	-7,527	1002	3.32	0.5%	($21,762)	$18,590	$1,868	>1	>1	$40,351	$23,630
CZ06-2	LADWP	-7,527	1002	3.32	0.5%	($21,762)	$19,309	$1,868	>1	>1	$41,071	$23,630
CZ07	SDG&E	-3,812	522	1.76	0.3%	($23,762)	$54,345	$1,318	>1	>1	$78,107	$25,080
CZ08	SCE	-5,805	793	2.70	0.4%	($26,922)	$16,735	$1,846	>1	>1	$43,658	$28,768
CZ08-2	LADWP	-5,805	793	2.70	0.4%	($26,922)	$17,130	$1,846	>1	>1	$44,052	$28,768
CZ09	SCE	-7,241	970	3.32	0.4%	($32,113)	$18,582	$1,978	>1	>1	$50,695	$34,091
CZ09-2	LADWP	-7,241	970	3.32	0.4%	($32,113)	$19,089	$1,978	>1	>1	$51,202	$34,091
CZ10	SDG&E	-10,336	1262	3.99	0.1%	($27,272)	$54,453	$505	>1	>1	$81,724	$27,777
CZ10-2	SCE	-10,336	1262	3.99	0.1%	($27,272)	$20,996	$505	>1	>1	$48,268	$27,777
CZ11	PG&E	-19,251	2415	7.95	0.5%	($32,202)	($7,951)	$2,615	4.1	>1	$24,251	$34,817
CZ12	PG&E	-19,471	2309	7.28	-0.1%	($32,504)	($14,153)	($461)	2.3	70.4	$18,351	$32,042
CZ12-2	SMUD	-19,471	2309	7.28	-0.1%	($32,504)	$12,939	($461)	>1	70.4	$45,443	$32,042
CZ13	PG&E	-16,819	1983	6.15	-0.4%	($28,158)	($10,575)	($2,022)	2.7	13.9	$17,582	$26,136
CZ14	SDG&E	-13,208	1672	5.44	0.7%	($26,656)	$41,117	$4,461	>1	>1	$67,772	$31,117
CZ14-2	SCE	-13,208	1672	5.44	0.7%	($26,656)	$18,467	$4,461	>1	>1	$45,123	$31,117
CZ15	SCE	-2,463	518	2.14	0.9%	($29,544)	$16,796	$5,823	>1	>1	$46,339	$35,367
CZ16	PG&E	-41,418	4304	13.23	-12.2%	($25,771)	($49,862)	($52,542)	0.5	0.5	($24,091)	($26,771)
CZ16-2	LADWP	-41,418	4304	13.23	-12.2%	($25,771)	$39,319	($52,542)	>1	0.5	$65,090	($26,771)

* The Incremental Package Cost is the addition of the incremental HVAC and water heating equipment costs from Figure 11 and the natural gas infrastructure incremental cost savings of $28,027 (see section 3.3.2.2).

Figure 28. Cost Effectiveness for Medium Retail Package 3A – All-Electric + EE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 3A: All-Electric + EE												
CZ01	PG&E	-5,478	3893	20.64	15%	($20,336)	$63,593	$51,224	>1	>1	$83,929	$71,560
CZ02	PG&E	2,843	2448	14.58	13%	($21,895)	$74,997	$56,893	>1	>1	$96,892	$78,788
CZ03	PG&E	7,791	1868	12.73	16%	($18,542)	$68,968	$56,586	>1	>1	$87,511	$75,128
CZ04	PG&E	8,572	1706	11.89	14%	($17,327)	$81,957	$57,904	>1	>1	$99,284	$75,231
CZ04-2	CPAU	8,572	1706	11.89	14%	($17,327)	$63,082	$57,904	>1	>1	$80,408	$75,231
CZ05	PG&E	6,973	1746	11.68	15%	($19,938)	$63,677	$51,949	>1	>1	$83,615	$71,887
CZ06	SCE	7,431	1002	7.72	11%	($19,050)	$47,072	$42,610	>1	>1	$66,122	$61,660
CZ06-2	LADWP	7,431	1002	7.72	11%	($19,050)	$37,078	$42,610	>1	>1	$56,128	$61,660
CZ07	SDG&E	14,350	522	6.98	13%	($18,193)	$127,461	$50,828	>1	>1	$145,654	$69,021
CZ08	SCE	8,524	793	6.90	10%	($24,210)	$43,679	$42,258	>1	>1	$67,890	$66,468
CZ08-2	LADWP	8,524	793	6.90	10%	($24,210)	$34,038	$42,258	>1	>1	$58,248	$66,468
CZ09	SCE	8,403	970	7.81	10%	($26,545)	$47,819	$47,356	>1	>1	$74,364	$73,901
CZ09-2	LADWP	8,403	970	7.81	10%	($26,545)	$37,934	$47,356	>1	>1	$64,478	$73,901
CZ10	SDG&E	11,737	1262	10.23	12%	($21,703)	$137,436	$58,761	>1	>1	$159,139	$80,464
CZ10-2	SCE	11,737	1262	10.23	12%	($21,703)	$58,257	$58,761	>1	>1	$79,959	$80,464
CZ11	PG&E	5,892	2415	15.13	12%	($26,633)	$85,256	$65,859	>1	>1	$111,889	$92,492
CZ12	PG&E	5,548	2309	14.46	12%	($26,935)	$80,631	$63,903	>1	>1	$107,566	$90,838
CZ12-2	SMUD	5,548	2309	14.46	12%	($26,935)	$59,311	$63,903	>1	>1	$86,246	$90,838
CZ13	PG&E	10,184	1983	14.15	14%	($25,446)	$110,105	$80,604	>1	>1	$135,551	$106,050
CZ14	SDG&E	16,583	1672	13.83	15%	($23,944)	$171,200	$88,471	>1	>1	$195,145	$112,415
CZ14-2	SCE	16,583	1672	13.83	15%	($23,944)	$656,178	$159,604	>1	>1	$680,122	$183,548
CZ15	SCE	23,642	518	9.44	12%	($26,832)	$65,573	$76,781	>1	>1	$92,404	$103,612
CZ16	PG&E	-18,232	4304	19.80	3%	($23,059)	$38,796	$14,152	>1	>1	$61,855	$37,211
CZ16-2	LADWP	-18,232	4304	19.80	3%	($23,059)	$67,793	$14,152	>1	>1	$90,852	$37,211

Figure 29. Cost Effectiveness for Medium Retail Package 3B – All-Electric + EE + PV + B

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Compliance Margin (%)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + PV + B												
CZ01	PG&E	137,956	3893	50.51	15%	$254,335	$510,831	$374,432	2.0	1.5	$256,496	$120,097
CZ02	PG&E	173,387	2448	49.87	13%	$252,777	$590,112	$463,431	2.3	1.8	$337,336	$210,654
CZ03	PG&E	180,055	1868	48.55	16%	$256,129	$585,861	$452,399	2.3	1.8	$329,732	$196,270
CZ04	PG&E	184,499	1706	48.38	14%	$257,345	$608,814	$481,011	2.4	1.9	$351,470	$223,666
CZ04-2	CPAU	184,499	1706	48.38	14%	$257,345	$465,690	$481,011	1.8	1.9	$208,345	$223,666
CZ05	PG&E	185,690	1746	48.84	15%	$254,734	$600,933	$461,804	2.4	1.8	$346,199	$207,071
CZ06	SCE	180,968	1002	43.91	11%	$255,621	$335,909	$457,959	1.3	1.8	$80,288	$202,337
CZ06-2	LADWP	180,968	1002	43.91	11%	$255,621	$206,021	$457,959	0.8	1.8	($49,601)	$202,337
CZ07	SDG&E	194,837	522	44.67	13%	$256,478	$550,714	$478,637	2.1	1.9	$294,236	$222,159
CZ08	SCE	184,120	793	43.32	10%	$250,461	$340,301	$479,406	1.4	1.9	$89,840	$228,945
CZ08-2	LADWP	184,120	793	43.32	10%	$250,461	$203,813	$479,406	0.8	1.9	($46,648)	$228,945
CZ09	SCE	186,346	970	44.77	10%	$248,127	$349,524	$474,176	1.4	1.9	$101,397	$226,049
CZ09-2	LADWP	186,346	970	44.77	10%	$248,127	$216,654	$474,176	0.9	1.9	($31,473)	$226,049
CZ10	SDG&E	191,923	1262	47.46	12%	$252,969	$593,514	$473,605	2.3	1.9	$340,545	$220,636
CZ10-2	SCE	191,923	1262	47.46	12%	$252,969	$356,958	$473,605	1.4	1.9	$103,989	$220,636
CZ11	PG&E	177,639	2415	50.26	12%	$248,039	$585,689	$489,317	2.4	2.0	$337,650	$241,278
CZ12	PG&E	176,919	2309	49.46	12%	$247,736	$591,104	$484,702	2.4	2.0	$343,368	$236,966
CZ12-2	SMUD	176,919	2309	49.46	12%	$247,736	$335,286	$484,702	1.4	2.0	$87,550	$236,966
CZ13	PG&E	183,129	1983	49.48	14%	$249,226	$608,560	$483,670	2.4	1.9	$359,334	$234,444
CZ14	SDG&E	208,183	1672	52.54	15%	$250,727	$593,232	$544,079	2.4	2.2	$342,505	$293,351
CZ14-2	SCE	264,589	1672	80.97	15%	$250,727	$656,178	$580,403	2.6	2.3	$405,450	$329,676
CZ15	SCE	205,869	518	45.67	12%	$247,840	$347,125	$493,339	1.4	2.0	$99,285	$245,499
CZ16	PG&E	176,114	4304	60.13	3%	$251,612	$567,822	$446,795	2.3	1.8	$316,210	$195,183
CZ16-2	LADWP	176,114	4304	60.13	3%	$251,612	$241,757	$446,795	1.0	1.8	($9,856)	$195,183

Figure 30. Cost Effectiveness for Medium Retail Package 3C – All-Electric + HE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 3C: All-Electric + HE												
CZ01	PG&E	-26,199	3893	14.76	-2%	($587)	$369	($5,757)	>1	0.1	$956	($5,170)
CZ02	PG&E	-16,989	2448	8.95	3%	($4,211)	$12,323	$11,251	>1	>1	$16,534	$15,463
CZ03	PG&E	-11,703	1868	7.15	2%	($2,213)	$9,159	$6,944	>1	>1	$11,372	$9,157
CZ04	PG&E	-10,675	1706	6.37	3%	($316)	$14,317	$11,383	>1	>1	$14,633	$11,700
CZ04-2	CPAU	-10,675	1706	6.37	3%	($316)	$20,599	$11,383	>1	>1	$20,915	$11,700
CZ05	PG&E	-11,969	1746	6.19	1%	($2,298)	$5,592	$1,824	>1	>1	$7,890	$4,122
CZ06	SCE	-3,919	1002	4.35	3%	$1,418	$29,751	$13,734	21.0	9.7	$28,333	$12,316
CZ06-2	LADWP	-3,919	1002	4.35	3%	$1,418	$25,891	$13,734	18.3	9.7	$24,473	$12,316
CZ07	SDG&E	-955	522	2.59	3%	($710)	$74,518	$11,229	>1	>1	$75,227	$11,939
CZ08	SCE	-2,224	793	3.74	4%	($3,719)	$28,067	$15,075	>1	>1	$31,785	$18,793
CZ08-2	LADWP	-2,224	793	3.74	4%	($3,719)	$23,848	$15,075	>1	>1	$27,566	$18,793
CZ09	SCE	-2,089	970	4.84	4%	($8,268)	$34,648	$21,162	>1	>1	$42,916	$29,430
CZ09-2	LADWP	-2,089	970	4.84	4%	($8,268)	$28,837	$21,162	>1	>1	$37,105	$29,430
CZ10	SDG&E	-4,868	1262	5.58	4%	($5,222)	$91,136	$20,041	>1	>1	$96,358	$25,263
CZ10-2	SCE	-4,868	1262	5.58	4%	($5,222)	$37,200	$20,041	>1	>1	$42,422	$25,263
CZ11	PG&E	-12,651	2415	9.95	5%	($8,217)	$29,015	$26,172	>1	>1	$37,232	$34,389
CZ12	PG&E	-13,479	2309	9.10	4%	($9,239)	$20,839	$21,228	>1	>1	$30,078	$30,466
CZ12-2	SMUD	-13,479	2309	9.10	4%	($9,239)	$26,507	$21,228	>1	>1	$35,746	$30,466
CZ13	PG&E	-9,935	1983	8.23	4%	($4,975)	$30,123	$24,063	>1	>1	$35,097	$29,037
CZ14	SDG&E	-5,407	1672	7.71	5%	$121	$88,669	$31,029	732.5	256.3	$88,547	$30,908
CZ14-2	SCE	-5,407	1672	7.71	5%	$121	$40,709	$31,029	336.3	256.3	$40,588	$30,908
CZ15	SCE	6,782	518	4.77	6%	($2,508)	$42,238	$37,379	>1	>1	$44,745	$39,887
CZ16	PG&E	-35,297	4304	15.03	-8%	$1,102	($21,384)	($33,754)	-19.4	-30.6	($22,486)	($34,856)
CZ16-2	LADWP	-35,297	4304	15.03	-8%	$1,102	$48,625	($33,754)	44.1	-30.6	$47,523	($34,856)

4.3 Cost Effectiveness Results – Small Hotel

The following issues must be considered when reviewing the Small Hotel results:

- The Small Hotel is a mix of residential and nonresidential space types, which results in different occupancy and load profiles than the office and retail prototypes.
- A potential laundry load has not been examined for the Small Hotel. The Reach Code Team attempted to characterize and apply the energy use intensity of laundry loads in hotels but did not find readily available data for use. Thus, cost effectiveness including laundry systems has not been examined.
- Contrary to the office and retail prototypes, the Small Hotel baseline water heater is a central gas storage type. Current compliance software cannot model central heat pump water heater systems with recirculation serving guest rooms.[23] The only modeling option for heat pump water heating is individual water heaters at each guest room even though this is a very uncommon configuration. TRC modeled individual heat pump water heaters but as a proxy for central heat pump water heating performance, but integrated costs associated with tank and controls for central heat pump water heating into cost effectiveness calculations.
- Assuming central heat pump water heating also enabled the inclusion of a solar hot water thermal collection system, which was a key efficiency measure to achieving compliance in nearly all climate zones.

Figure 31 through Figure 37 contain the cost-effectiveness findings for the Small Hotel packages. Notable findings for each package include:

- **1A – Mixed-Fuel + EE:**
  - Packages achieve +3 to +10% compliance margins depending on climate zone.
  - Packages are cost effective using either the On-Bill or TDV approach in all CZs except 12 (using SMUD rates), 14 (using SCE rates), and 15 (with SCE rates).
  - The hotel is primarily guest rooms with a smaller proportion of nonresidential space. Thus, the inexpensive VAV minimum flow measure and lighting measures that have been applied to the entirety of the Medium Office and Medium Retail prototypes have a relatively small impact in the Small Hotel.[24]
- **1B – Mixed-Fuel + EE + PV + B:** Packages are cost effective using either the On-Bill or TDV approach in all CZs. Solar PV generally increases cost effectiveness compared to efficiency-only, particularly when using an NPV metric.
- **1C – Mixed-Fuel + HE:** Packages achieve +2 to +5% compliance margins depending on climate zone. The package is cost effective using the On-Bill approach in a minority of climate zones, and cost effective using TDV approach only in CZ15.

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[23] The IOUs and CEC are actively working on including central heat pump water heater modeling with recirculation systems in early 2020.

[24] Title 24 requires that hotel/motel guest room lighting design comply with the residential lighting standards, which are all mandatory and are not awarded compliance credit for improved efficacy.

- **2 – All-Electric Federal Code-Minimum Reference:**
  - This all-electric design does not comply with the Energy Commission's TDV performance budget. Packages achieve between -50% and -4% compliance margins depending on climate zone. This may be because the modeled HW system is constrained to having an artificially low efficiency to avoid triggering federal pre-emption, and the heat pump space heating systems must operate overnight when operation is less efficient.
  - All packages are cost effective in all climate zones.
- **3A – All-Electric + EE:** Packages achieve positive compliance margins in all CZs ranging from 0% to +17%, except CZ16 which had a -18% compliance margin. All packages are cost effective in all climate zones. The improved degree of cost effectiveness outcomes in Package 3A compared to Package 1A appear to be due to the significant incremental package cost savings.
- **3B – All-Electric + EE + PV + B:** All packages are cost effective. Packages improve in B/C ratio when compared to 3A and increase in magnitude of overall NPV savings. PV appears to be more cost-effective with higher building electricity loads.
- **3C – All-Electric + HE:**
  - Packages do not comply with Title 24 in all CZs except CZ15 which resulted in a +0.04% compliance margin.
  - All packages are cost effective.

ATTACHMENT 4

Figure 31. Cost Effectiveness for Small Hotel Package 1A – Mixed-Fuel + EE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 1A: Mixed Fuel + EE												
CZ01	PG&E	3,855	1288	5.65	9%	$20,971	$34,339	$36,874	1.6	1.8	$13,368	$15,903
CZ02	PG&E	3,802	976	3.91	7%	$20,971	$26,312	$29,353	1.3	1.4	$5,341	$8,381
CZ03	PG&E	4,153	1046	4.48	10%	$20,971	$31,172	$35,915	1.5	1.7	$10,201	$14,944
CZ04	PG&E	5,007	395	0.85	6%	$21,824	$24,449	$24,270	1.1	1.1	$2,625	$2,446
CZ04-2	CPAU	4,916	422	0.98	6%	$21,824	$18,713	$24,306	0.9	1.1	($3,111)	$2,483
CZ05	PG&E	3,530	1018	4.13	9%	$20,971	$28,782	$34,448	1.4	1.6	$7,810	$13,477
CZ05-2	SCG	3,530	1018	4.13	9%	$20,971	$23,028	$34,448	1.1	1.6	$2,057	$13,477
CZ06	SCE	5,137	418	1.16	8%	$21,824	$16,001	$26,934	0.7	1.2	($5,823)	$5,110
CZ06-2	LADWP	5,137	418	1.16	8%	$21,824	$11,706	$26,934	0.5	1.2	($10,118)	$5,110
CZ07	SDG&E	5,352	424	1.31	8%	$21,824	$26,699	$27,975	1.2	1.3	$4,876	$6,152
CZ08	SCE	5,151	419	1.21	7%	$21,824	$15,931	$23,576	0.7	1.1	($5,893)	$1,752
CZ08-2	LADWP	5,151	419	1.21	7%	$21,824	$11,643	$23,576	0.5	1.1	($10,180)	$1,752
CZ09	SCE	5,229	406	1.16	6%	$21,824	$15,837	$22,365	0.7	1.0	($5,987)	$541
CZ09-2	LADWP	5,229	406	1.16	6%	$21,824	$11,632	$22,365	0.5	1.0	($10,192)	$541
CZ10	SDG&E	4,607	342	0.92	5%	$21,824	$25,506	$22,219	1.2	1.0	$3,683	$396
CZ10-2	SCE	4,607	342	0.92	5%	$21,824	$13,868	$22,219	0.6	1.0	($7,956)	$396
CZ11	PG&E	4,801	325	0.87	4%	$21,824	$22,936	$19,503	1.1	0.9	$1,112	($2,321)
CZ12	PG&E	5,276	327	0.90	5%	$21,824	$22,356	$21,305	1.0	0.98	$532	($519)
CZ12-2	SMUD	5,276	327	0.90	5%	$21,824	$15,106	$21,305	0.7	0.98	($6,717)	($519)
CZ13	PG&E	4,975	310	0.87	4%	$21,824	$23,594	$19,378	1.1	0.9	$1,770	($2,445)
CZ14	SDG&E	4,884	370	0.82	4%	$21,824	$24,894	$21,035	1.1	0.96	$3,070	($789)
CZ14-2	SCE	4,884	370	0.82	4%	$21,824	$14,351	$21,035	0.7	0.96	($7,473)	($789)
CZ15	SCE	5,187	278	1.23	3%	$21,824	$13,645	$18,089	0.6	0.8	($8,178)	($3,735)
CZ16	PG&E	2,992	1197	4.95	6%	$20,971	$27,813	$30,869	1.3	1.5	$6,842	$9,898
CZ16-2	LADWP	2,992	1197	4.95	6%	$20,971	$19,782	$30,869	0.9	1.5	($1,190)	$9,898

Figure 32. Cost Effectiveness for Small Hotel Package 1B – Mixed-Fuel + EE + PV + B

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 1B: Mixed Fuel + EE + PV + B												
CZ01	PG&E	107,694	1288	28.73	9%	$228,341	$366,509	$295,731	1.6	1.3	$138,168	$67,390
CZ02	PG&E	130,144	976	31.14	7%	$228,341	$359,248	$336,575	1.6	1.5	$130,907	$108,233
CZ03	PG&E	129,107	1046	31.57	10%	$228,341	$430,737	$335,758	1.9	1.5	$202,396	$107,416
CZ04	PG&E	132,648	395	28.46	6%	$229,194	$355,406	$338,455	1.6	1.5	$126,212	$109,262
CZ04-2	CPAU	132,556	422	28.59	6%	$229,194	$322,698	$338,492	1.4	1.5	$93,504	$109,298
CZ05	PG&E	136,318	1018	32.73	9%	$228,341	$452,611	$352,342	2.0	1.5	$224,269	$124,001
CZ05-2	SCG	136,318	1018	32.73	9%	$228,341	$446,858	$352,342	2.0	1.5	$218,516	$124,001
CZ06	SCE	131,051	418	28.47	8%	$229,194	$217,728	$336,843	0.9	1.5	($11,466)	$107,649
CZ06-2	LADWP	131,051	418	28.47	8%	$229,194	$131,052	$336,843	0.6	1.5	($98,142)	$107,649
CZ07	SDG&E	136,359	424	29.63	8%	$229,194	$306,088	$345,378	1.3	1.5	$76,894	$116,184
CZ08	SCE	132,539	419	28.85	7%	$229,194	$227,297	$353,013	1.0	1.5	($1,897)	$123,819
CZ08-2	LADWP	132,539	419	28.85	7%	$229,194	$134,739	$353,013	0.6	1.5	($94,455)	$123,819
CZ09	SCE	131,422	406	28.82	6%	$229,194	$230,791	$343,665	1.0	1.5	$1,597	$114,471
CZ09-2	LADWP	131,422	406	28.82	6%	$229,194	$136,024	$343,665	0.6	1.5	($93,170)	$114,471
CZ10	SDG&E	134,146	342	29.05	5%	$229,194	$339,612	$342,574	1.5	1.5	$110,418	$113,380
CZ10-2	SCE	134,146	342	29.05	5%	$229,194	$226,244	$342,574	1.0	1.5	($2,949)	$113,380
CZ11	PG&E	128,916	325	27.62	4%	$229,194	$352,831	$337,208	1.5	1.5	$123,637	$108,014
CZ12	PG&E	131,226	327	28.04	5%	$229,194	$425,029	$338,026	1.9	1.5	$195,835	$108,832
CZ12-2	SMUD	131,226	327	28.04	5%	$229,194	$213,176	$338,026	0.9	1.5	($16,018)	$108,832
CZ13	PG&E	127,258	310	27.33	4%	$229,194	$351,244	$324,217	1.5	1.4	$122,050	$95,023
CZ14	SDG&E	147,017	370	30.96	4%	$229,194	$861,445	$217,675	3.8	0.9	$632,251	($11,518)
CZ14-2	SCE	147,017	370	30.96	4%	$229,194	$244,100	$381,164	1.1	1.7	$14,906	$151,970
CZ15	SCE	137,180	278	29.12	3%	$229,194	$225,054	$348,320	1.0	1.5	($4,140)	$119,127
CZ16	PG&E	141,478	1197	34.60	6%	$228,341	$377,465	$357,241	1.7	1.6	$149,124	$128,899
CZ16-2	LADWP	141,478	1197	34.60	6%	$228,341	$136,563	$357,241	0.6	1.6	($91,778)	$128,899

Figure 33. Cost Effectiveness for Small Hotel Package 1C – Mixed-Fuel + HE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 1C: Mixed Fuel + HE												
CZ01	PG&E	10	632	3.76	2%	$22,839	$11,015	$10,218	0.5	0.4	($11,823)	($12,621)
CZ02	PG&E	981	402	2.69	3%	$23,092	$16,255	$11,808	0.7	0.5	($6,837)	($11,284)
CZ03	PG&E	81	383	2.30	2%	$20,510	$7,066	$6,850	0.3	0.3	($13,444)	($13,660)
CZ04	PG&E	161	373	2.26	2%	$22,164	$8,593	$7,645	0.4	0.3	($13,571)	($14,519)
CZ04-2	CPAU	161	373	2.26	2%	$22,164	$7,097	$7,645	0.3	0.3	($15,067)	($14,519)
CZ05	PG&E	154	361	2.19	2%	$21,418	$6,897	$6,585	0.3	0.3	($14,521)	($14,833)
CZ05-2	SCG	154	361	2.19	2%	$21,418	$4,786	$6,585	0.2	0.3	($16,632)	($14,833)
CZ06	SCE	237	201	1.27	2%	$20,941	$3,789	$4,882	0.2	0.2	($17,152)	($16,059)
CZ06-2	LADWP	237	201	1.27	2%	$20,941	$3,219	$4,882	0.2	0.2	($17,722)	($16,059)
CZ07	SDG&E	1,117	158	1.28	2%	$19,625	$13,771	$7,342	0.7	0.4	($5,854)	($12,283)
CZ08	SCE	1,302	169	1.39	2%	$20,678	$8,378	$8,591	0.4	0.4	($12,300)	($12,088)
CZ08-2	LADWP	1,302	169	1.39	2%	$20,678	$5,802	$8,591	0.3	0.4	($14,877)	($12,088)
CZ09	SCE	1,733	178	1.56	3%	$20,052	$10,489	$11,164	0.5	0.6	($9,563)	($8,888)
CZ09-2	LADWP	1,733	178	1.56	3%	$20,052	$7,307	$11,164	0.4	0.6	($12,745)	($8,888)
CZ10	SDG&E	3,170	220	2.29	4%	$22,682	$35,195	$19,149	1.6	0.8	$12,513	($3,533)
CZ10-2	SCE	3,170	220	2.29	4%	$22,682	$16,701	$19,149	0.7	0.8	($5,981)	($3,533)
CZ11	PG&E	3,343	323	2.96	4%	$23,344	$27,633	$20,966	1.2	0.9	$4,288	($2,379)
CZ12	PG&E	1,724	320	2.44	4%	$22,302	$11,597	$15,592	0.5	0.7	($10,705)	($6,710)
CZ12-2	SMUD	1,724	320	2.44	4%	$22,302	$11,156	$15,592	0.5	0.7	($11,146)	($6,710)
CZ13	PG&E	3,083	316	2.81	3%	$22,882	$23,950	$17,068	1.0	0.7	$1,068	($5,814)
CZ14	SDG&E	3,714	312	2.99	4%	$23,299	$35,301	$21,155	1.5	0.9	$12,002	($2,144)
CZ14-2	SCE	3,714	312	2.99	4%	$23,299	$18,460	$21,155	0.8	0.9	($4,839)	($2,144)
CZ15	SCE	8,684	97	3.21	5%	$20,945	$26,738	$31,600	1.3	1.5	$5,792	$10,655
CZ16	PG&E	836	700	4.42	3%	$24,616	$18,608	$14,494	0.8	0.6	($6,007)	($10,121)
CZ16-2	LADWP	836	700	4.42	3%	$24,616	$15,237	$14,494	0.6	0.6	($9,378)	($10,121)

Figure 34. Cost Effectiveness for Small Hotel Package 2 – All-Electric Federal Code Minimum

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost*	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 2: All-Electric Federal Code Minimum												
CZ01	PG&E	-159,802	16917	53.92	-28%	($1,296,784)	($582,762)	($115,161)	2.2	11.3	$714,022	$1,181,623
CZ02	PG&E	-118,739	12677	40.00	-12%	($1,297,757)	($245,434)	($51,620)	5.3	25.1	$1,052,322	$1,246,137
CZ03	PG&E	-110,595	12322	40.48	-14%	($1,300,029)	($326,633)	($51,166)	4.0	25.4	$973,396	$1,248,863
CZ04	PG&E	-113,404	11927	36.59	-13%	($1,299,864)	($225,307)	($53,134)	5.8	24.5	$1,074,556	$1,246,730
CZ04-2	CPAU	-113,404	11927	36.59	-13%	($1,299,864)	($17,768)	($53,134)	73.2	24.5	$1,282,096	$1,246,730
CZ05	PG&E	-108,605	11960	38.34	-15%	($1,299,917)	($350,585)	($54,685)	3.7	23.8	$949,332	$1,245,232
CZ06	SCE	-78,293	8912	29.36	-5%	($1,300,058)	($61,534)	($28,043)	21.1	46.4	$1,238,524	$1,272,015
CZ06-2	LA	-78,293	8912	29.36	-5%	($1,300,058)	$43,200	($28,043)	>1	46.4	$1,343,258	$1,272,015
CZ07	SDG&E	-69,819	8188	28.04	-7%	($1,298,406)	($137,638)	($23,199)	9.4	56.0	$1,160,768	$1,275,207
CZ08	SCE	-71,914	8353	28.21	-6%	($1,296,376)	($53,524)	($22,820)	24.2	56.8	$1,242,852	$1,273,556
CZ08-2	LA	-71,914	8353	28.21	-6%	($1,296,376)	$42,841	($22,820)	>1	56.8	$1,339,217	$1,273,556
CZ09	SCE	-72,262	8402	28.38	-6%	($1,298,174)	($44,979)	($21,950)	28.9	59.1	$1,253,196	$1,276,224
CZ09-2	LA	-72,262	8402	28.38	-6%	($1,298,174)	$46,679	($21,950)	>1	59.1	$1,344,853	$1,276,224
CZ10	SDG&E	-80,062	8418	26.22	-8%	($1,295,176)	($172,513)	($36,179)	7.5	35.8	$1,122,663	$1,258,997
CZ10-2	SCE	-80,062	8418	26.22	-8%	($1,295,176)	($63,974)	($36,179)	20.2	35.8	$1,231,202	$1,258,997
CZ11	PG&E	-99,484	10252	30.99	-10%	($1,295,985)	($186,037)	($49,387)	7.0	26.2	$1,109,948	$1,246,598
CZ12	PG&E	-99,472	10403	32.08	-10%	($1,297,425)	($340,801)	($45,565)	3.8	28.5	$956,624	$1,251,860
CZ12-2	SMUD	-99,067	10403	32.21	-10%	($1,297,425)	$5,794	($44,354)	>1	29.3	$1,303,219	$1,253,071
CZ13	PG&E	-96,829	10029	30.60	-10%	($1,295,797)	($184,332)	($50,333)	7.0	25.7	$1,111,465	$1,245,464
CZ14	SDG&E	-101,398	10056	29.68	-11%	($1,296,156)	($325,928)	($56,578)	4.0	22.9	$970,228	$1,239,578
CZ14-2	SCE	-101,398	10056	29.68	-11%	($1,296,156)	($121,662)	($56,578)	10.7	22.9	$1,174,494	$1,239,578
CZ15	SCE	-49,853	5579	18.07	-4%	($1,294,276)	$209	($21,420)	>1	60.4	$1,294,485	$1,272,856
CZ16	PG&E	-216,708	17599	41.89	-50%	($1,300,552)	($645,705)	($239,178)	2.0	5.4	$654,847	$1,061,374
CZ16-2	LA	-216,708	17599	41.89	-50%	($1,300,552)	$30,974	($239,178)	>1	5.4	$1,331,526	$1,061,374

* The Incremental Package Cost is the addition of the incremental HVAC and water heating equipment costs from Figure 12, the electrical infrastructure incremental cost of $26,800 (see section 3.3.2.1), and the natural gas infrastructure incremental cost savings of $56,020 (see section 3.3.2.2).

Figure 35. Cost Effectiveness for Small Hotel Package 3A – All-Electric + EE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 3A: All-Electric + EE												
CZ01	PG&E	-113,259	16917	62.38	1.3%	($1,251,544)	($200,367)	$5,460	6.2	>1	$1,051,177	$1,257,005
CZ02	PG&E	-90,033	12677	45.46	4%	($1,265,064)	($108,075)	$15,685	11.7	>1	$1,156,989	$1,280,749
CZ03	PG&E	-83,892	12322	45.93	6%	($1,267,509)	($198,234)	$20,729	6.4	>1	$1,069,274	$1,288,237
CZ04	PG&E	-91,197	11927	40.36	0.2%	($1,263,932)	($112,892)	$703	11.2	>1	$1,151,041	$1,264,635
CZ04-2	CPAU	-90,981	11927	40.42	0.2%	($1,263,932)	$32,557	$918	>1	>1	$1,296,489	$1,264,850
CZ05	PG&E	-82,491	11960	43.62	5%	($1,267,355)	($221,492)	$18,488	5.7	>1	$1,045,863	$1,285,843
CZ06	SCE	-61,523	8912	32.45	7%	($1,267,916)	($33,475)	$15,142	37.9	>1	$1,234,441	$1,283,057
CZ06-2	LADWP	-61,523	8912	32.45	7%	($1,267,916)	$57,215	$15,142	>1	>1	$1,325,130	$1,283,057
CZ07	SDG&E	-53,308	8188	31.22	7%	($1,266,354)	($81,338)	$22,516	15.6	>1	$1,185,015	$1,288,870
CZ08	SCE	-55,452	8353	31.33	3%	($1,264,408)	($23,893)	$9,391	52.9	>1	$1,240,515	$1,273,800
CZ08-2	LADWP	-55,452	8353	31.33	3%	($1,264,408)	$57,058	$9,391	>1	>1	$1,321,466	$1,273,800
CZ09	SCE	-55,887	8402	31.40	2%	($1,266,302)	($19,887)	$9,110	63.7	>1	$1,246,415	$1,275,412
CZ09-2	LADWP	-55,887	8402	31.40	2%	($1,266,302)	$60,441	$9,110	>1	>1	$1,326,743	$1,275,412
CZ10	SDG&E	-60,239	8418	29.96	2%	($1,256,002)	($126,072)	$7,365	10.0	>1	$1,129,930	$1,263,367
CZ10-2	SCE	-60,239	8418	29.96	2%	($1,256,002)	($33,061)	$7,365	38.0	>1	$1,222,940	$1,263,367
CZ11	PG&E	-77,307	10252	35.12	1%	($1,256,149)	($80,187)	$3,114	15.7	>1	$1,175,962	$1,259,263
CZ12	PG&E	-75,098	10403	36.73	2%	($1,256,824)	($234,275)	$9,048	5.4	>1	$1,022,550	$1,265,872
CZ12-2	SMUD	-75,098	10403	36.73	2%	($1,256,824)	$54,941	$9,048	>1	>1	$1,311,765	$1,265,872
CZ13	PG&E	-75,052	10029	34.72	0.3%	($1,256,109)	($79,378)	$1,260	15.8	>1	$1,176,731	$1,257,369
CZ14	SDG&E	-76,375	10056	34.28	0.1%	($1,255,704)	($170,975)	$543	7.3	>1	$1,084,729	$1,256,247
CZ14-2	SCE	-76,375	10056	34.28	0.1%	($1,255,704)	($34,418)	$543	36.5	>1	$1,221,286	$1,256,247
CZ15	SCE	-33,722	5579	21.43	2%	($1,257,835)	$26,030	$12,262	>1	>1	$1,283,864	$1,270,097
CZ16	PG&E	-139,676	17599	55.25	-14%	($1,255,364)	($197,174)	($66,650)	6.4	18.8	$1,058,190	$1,188,714
CZ16-2	LADWP	-139,676	17599	55.25	-14%	($1,255,364)	$165,789	($66,650)	>1	18.8	$1,421,153	$1,188,714

Figure 36. Cost Effectiveness for Small Hotel Package 3B – All-Electric + EE + PV + B

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 3B: All-Electric + EE + PV + B												
CZ01	PG&E	-8,900	16917	87.15	1%	($1,044,174)	$90,964	$324,376	>1	>1	$1,135,139	$1,368,551
CZ02	PG&E	36,491	12677	73.03	4%	($1,057,694)	$242,514	$313,711	>1	>1	$1,300,208	$1,371,405
CZ03	PG&E	41,239	12322	73.43	6%	($1,060,139)	$155,868	$308,385	>1	>1	$1,216,007	$1,368,524
CZ04	PG&E	36,628	11927	69.70	0.2%	($1,056,562)	$240,799	$308,682	>1	>1	$1,297,361	$1,365,244
CZ04-2	CPAU	36,844	11927	69.76	0.2%	($1,056,562)	$336,813	$418,836	>1	>1	$1,393,375	$1,475,398
CZ05	PG&E	36,365	11960	73.11	5%	($1,059,985)	$119,173	$317,952	>1	>1	$1,179,158	$1,377,937
CZ06	SCE	64,476	8912	60.47	7%	($1,060,545)	$156,327	$311,730	>1	>1	$1,216,872	$1,372,275
CZ06-2	LADWP	64,476	8912	60.47	7%	($1,060,545)	$180,648	$311,730	>1	>1	$1,241,193	$1,372,275
CZ07	SDG&E	77,715	8188	60.45	7%	($1,058,983)	$197,711	$330,458	>1	>1	$1,256,694	$1,389,441
CZ08	SCE	71,990	8353	59.49	3%	($1,057,038)	$165,393	$320,814	>1	>1	$1,222,432	$1,377,852
CZ08-2	LADWP	71,990	8353	60.24	3%	($1,057,038)	$180,367	$443,809	>1	>1	$1,237,405	$1,500,847
CZ09	SCE	70,465	8402	59.29	2%	($1,058,932)	$175,602	$301,459	>1	>1	$1,234,534	$1,360,391
CZ09-2	LADWP	70,465	8402	59.29	2%	($1,058,932)	$183,220	$301,459	>1	>1	$1,242,152	$1,360,391
CZ10	SDG&E	69,581	8418	58.04	2%	($1,048,632)	$161,513	$294,530	>1	>1	$1,210,145	$1,343,162
CZ10-2	SCE	69,581	8418	58.04	2%	($1,048,632)	$164,837	$294,530	>1	>1	$1,213,469	$1,343,162
CZ11	PG&E	47,260	10252	61.57	1%	($1,048,779)	$253,717	$286,797	>1	>1	$1,302,496	$1,335,576
CZ12	PG&E	51,115	10403	64.07	2%	($1,049,454)	$104,523	$305,446	>1	>1	$1,153,977	$1,354,900
CZ12-2	SMUD	51,115	10403	64.99	2%	($1,049,454)	$253,197	$430,977	>1	>1	$1,302,651	$1,480,431
CZ13	PG&E	47,757	10029	60.77	0.3%	($1,048,739)	$251,663	$281,877	>1	>1	$1,300,402	$1,330,616
CZ14	SDG&E	66,084	10056	64.54	0.1%	($1,048,334)	$148,510	$334,938	>1	>1	$1,196,844	$1,383,272
CZ14-2	SCE	66,084	10056	64.54	0.1%	($1,048,334)	$185,018	$334,938	>1	>1	$1,233,352	$1,383,272
CZ15	SCE	98,755	5579	49.04	2.1%	($1,050,465)	$233,308	$311,121	>1	>1	$1,283,772	$1,361,585
CZ16	PG&E	-873	17599	84.99	-14%	($1,047,994)	$191,994	$240,724	>1	>1	$1,239,987	$1,288,718
CZ16-2	LADWP	-873	17599	84.99	-14%	($1,047,994)	$291,279	$240,724	>1	>1	$1,339,273	$1,288,718

Figure 37. Cost Effectiveness for Small Hotel Package 3C – All-Electric + HE

CZ	Utility	Elec Savings (kWh)	Gas Savings (therms)	GHG Reductions (mtons)	Comp-liance Margin	Incremental Package Cost	Lifecycle Utility Cost Savings	$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Package 3C: All-Electric + HE												
CZ01	PG&E	-154,840	16917	56.24	-24%	($1,281,338)	($606,619)	($101,272)	2.1	12.7	$674,719	$1,180,066
CZ02	PG&E	-118,284	12677	41.18	-11%	($1,283,243)	($395,641)	($44,505)	3.2	28.8	$887,602	$1,238,738
CZ03	PG&E	-113,413	12322	40.80	-14%	($1,288,782)	($522,458)	($51,582)	2.5	25.0	$766,324	$1,237,200
CZ04	PG&E	-115,928	11927	37.09	-13%	($1,287,878)	($383,177)	($53,285)	3.4	24.2	$904,701	$1,234,593
CZ04-2	CPAU	-115,928	11927	37.09	-13%	($1,287,878)	($24,170)	($53,285)	53.3	24.2	$1,263,708	$1,234,593
CZ05	PG&E	-111,075	11960	38.75	-15%	($1,288,242)	($530,740)	($56,124)	2.4	23.0	$757,502	$1,232,119
CZ06	SCE	-83,000	8912	29.41	-15%	($1,288,695)	($154,625)	($32,244)	8.3	40.0	$1,134,069	$1,256,451
CZ06-2	LADWP	-83,000	8912	29.41	-15%	($1,288,695)	($17,626)	($32,244)	73.1	40.0	$1,271,068	$1,256,451
CZ07	SDG&E	-73,823	8188	28.32	-7%	($1,285,759)	($268,207)	($24,069)	4.8	53.4	$1,017,552	$1,261,690
CZ08	SCE	-75,573	8353	28.56	-6%	($1,281,241)	($157,393)	($21,912)	8.1	58.5	$1,123,848	$1,259,329
CZ08-2	LADWP	-75,573	8353	28.56	-6%	($1,281,241)	($18,502)	($21,912)	69.2	58.5	$1,262,739	$1,259,329
CZ09	SCE	-74,790	8402	29.04	-4%	($1,285,139)	($138,746)	($16,992)	9.3	75.6	$1,146,393	$1,268,147
CZ09-2	LADWP	-74,790	8402	29.04	-4%	($1,285,139)	($6,344)	($16,992)	202.6	75.6	$1,278,794	$1,268,147
CZ10	SDG&E	-80,248	8418	27.57	-5%	($1,278,097)	($235,479)	($24,107)	5.4	53.0	$1,042,617	$1,253,990
CZ10-2	SCE	-80,248	8418	27.57	-5%	($1,278,097)	($123,371)	($24,107)	10.4	53.0	$1,154,726	$1,253,990
CZ11	PG&E	-98,041	10252	32.73	-7%	($1,279,528)	($278,242)	($35,158)	4.6	36.4	$1,001,286	$1,244,370
CZ12	PG&E	-100,080	10403	33.24	-9%	($1,282,834)	($480,347)	($38,715)	2.7	33.1	$802,487	$1,244,119
CZ12-2	SMUD	-100,080	10403	33.24	-9%	($1,282,834)	($23,362)	($38,715)	54.9	33.1	$1,259,472	$1,244,119
CZ13	PG&E	-94,607	10029	32.47	-7%	($1,279,301)	($276,944)	$244,552	4.6	>1	$1,002,357	$1,523,853
CZ14	SDG&E	-97,959	10056	31.91	-7%	($1,279,893)	($302,123)	($37,769)	4.2	33.9	$977,770	$1,242,124
CZ14-2	SCE	-97,959	10056	31.91	-7%	($1,279,893)	($129,082)	($37,769)	9.9	33.9	$1,150,811	$1,242,124
CZ15	SCE	-45,226	5579	20.17	0.04%	($1,276,847)	($6,533)	$227	195.4	>1	$1,270,314	$1,277,074
CZ16	PG&E	-198,840	17599	47.73	-39%	($1,288,450)	($605,601)	($185,438)	2.1	6.9	$682,848	$1,103,011
CZ16-2	LADWP	-198,840	17599	47.73	-39%	($1,288,450)	$40,268	($185,438)	>1	6.9	$1,328,718	$1,103,011

4.4 Cost Effectiveness Results – PV-only and PV+Battery

The Reach Code Team ran packages of PV-only and PV+Battery measures, without any additional efficiency measures, to assess cost effectiveness on top of the mixed-fuel baseline building and the all-electric federal code minimum reference (Package 2 in Sections 4.1 – 4.3).

Jurisdictions interested in adopting PV-only reach codes should reference the mixed-fuel cost effectiveness results because a mixed-fuel building is the baseline for the nonresidential prototypes analyzed in this study. PV or PV+Battery packages are added to all-electric federal code minimum reference which (in many scenarios) do not have a positive compliance margin compared to the mixed-fuel baseline model, and are solely provided for informational purposes. Jurisdictions interested in reach codes requiring all-electric+PV or all-electric+PV+battery should reference package 3B results in Sections 4.1 – 4.3.[25]

Each of the following eight packages were evaluated against a mixed fuel baseline designed as per 2019 Title 24 Part 6 requirements.

- **Mixed-Fuel + 3 kW PV Only:**
- **Mixed-Fuel + 3 kW PV + 5 kWh battery**
- **Mixed-Fuel + PV Only**: PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller
- **Mixed-Fuel + PV + 50 kWh Battery:** PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller, along with 50 kWh battery
- **All-Electric + 3 kW PV Only**
- **All-Electric + 3 kW PV + 5 kWh Battery**
- **All-Electric + PV Only**: PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller
- **All-Electric + PV + 50 kWh Battery:** PV sized per the roof size of the building, or to offset the annual electricity consumption, whichever is smaller, along with 50 kWh battery

Figure 38 through Figure 40 summarize the on-bill and TDV B/C ratios for each prototype for the two PV only packages and the two PV plus battery packages. Compliance margins are 0 percent for all mixed-fuel packages. For all-electric packages, compliance margins are equal to those found in Package 2 for each prototype in Sections 4.1 – 4.3. The compliance margins are not impacted by renewables and battery storage measures and hence not shown in the tables. These figures are formatted in the following way:

- Cells highlighted in green have a B/C ratio greater than 1 and are cost-effective. The shade of green gets darker as cost effectiveness increases.
- Cells not highlighted have a B/C ratio less than one and are not cost effective.

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[25] Because this study shows that the addition of battery generally reduces cost effectiveness, removing a battery measure would only increase cost effectiveness. Thus, a jurisdiction can apply the EE+PV+Battery cost effectiveness findings to support EE+PV reach codes, because EE+PV would still remain cost effective without a battery.

Please see Appendix 6.7 for results in full detail. Generally, for mixed-fuel packages across all prototypes, all climate zones were proven to have cost effective outcomes using TDV except in CZ1 with a 3 kW PV + 5 kWh Battery scenario. Most climate zones also had On-Bill cost effectiveness. The addition of a battery slightly reduces cost effectiveness.

In all-electric packages, the results for most climate zones were found cost effective using both TDV and On-Bill approaches with larger PV systems or PV+Battery systems. Most 3 kW PV systems were also found to be cost effective except in some scenarios analyzing the Medium Office using the On-Bill method. CZ16 results continue to show challenges being cost effective with all electric buildings, likely due to the high heating loads in this climate. The addition of a battery slightly reduces the cost effectiveness for all-electric buildings with PV.

Figure 38. Cost Effectiveness for Medium Office - PV and Battery

		Mixed Fuel								All-Electric							
	PV	**3kW**		**3kW**		**135kW**		**135kW**		**3kW**		**3kW**		**135kW**		**135kW**	
	Battery	**0**		**5kWh**		**0**		**50kWh**		**0**		**5kWh**		**0**		**50kWh**	
CZ	**Utility**	**On-Bill**	**TDV**	**On-Bill**	**TDV**	**On-Bill**	**TDV**	**On-Bill**	**TDV**	**On-Bill**	**TDV**	**On-Bill**	**TDV**	**On-Bill**	**TDV**	**On-Bill**	**TDV**
CZ01	PG&E	2.8	1.5	1.7	0.9	1.7	1.3	1.6	1.2	0.9	1.6	0.9	1.6	2.5	2.0	2.1	1.7
CZ02	PG&E	3.7	1.9	2.1	1.1	2.2	1.6	2.0	1.4	0.8	2.2	0.9	2.6	3.2	2.4	2.7	2.1
CZ03	PG&E	3.7	1.8	2.2	1.0	2.1	1.5	1.9	1.4	1.9	3.9	2.0	4.0	3.4	2.5	2.9	2.2
CZ04	PG&E	3.6	2.0	2.1	1.2	2.3	1.6	2.1	1.5	0.9	2.1	1.1	2.7	3.3	2.5	2.9	2.2
CZ04-2	CPAU	2.1	2.0	1.3	1.2	1.8	1.6	1.6	1.5	7.7	2.1	9.8	2.7	2.9	2.5	2.5	2.2
CZ05	PG&E	4.2	1.9	2.4	1.1	2.5	1.6	2.3	1.5	1.8	2.7	1.9	2.7	4.0	2.7	3.4	2.3
CZ05-2	SCG	4.2	1.9	2.4	1.1	2.5	1.6	2.3	1.5	>1	>1	>1	>1	>1	3.0	9.4	2.6
CZ06	SCE	2.0	2.0	1.2	1.1	1.3	1.6	1.2	1.5	>1	7.2	>1	8.2	2.4	2.7	2.1	2.3
CZ06-2	LA	1.2	2.0	0.7	1.1	0.8	1.6	0.7	1.5	>1	7.2	>1	8.2	1.5	2.7	1.3	2.3
CZ07	SDG&E	3.2	2.0	1.9	1.2	2.1	1.6	1.9	1.5	>1	>1	>1	>1	3.7	2.7	3.2	2.3
CZ08	SCE	1.9	2.0	1.1	1.2	1.3	1.7	1.2	1.5	>1	>1	>1	>1	2.2	2.7	1.9	2.4
CZ08-2	LA	1.2	2.0	0.7	1.2	0.7	1.7	0.7	1.5	>1	>1	>1	>1	1.3	2.7	1.1	2.4
CZ09	SCE	1.9	2.0	1.1	1.2	1.3	1.7	1.2	1.5	>1	>1	>1	>1	2.2	2.6	1.9	2.3
CZ09-2	LA	1.1	2.0	0.7	1.2	0.7	1.7	0.7	1.5	>1	>1	>1	>1	1.3	2.6	1.2	2.3
CZ10	SDG&E	3.8	1.9	2.2	1.1	2.1	1.6	1.9	1.5	>1	3.3	>1	6.3	3.3	2.3	2.9	2.0
CZ10-2	SCE	2.1	1.9	1.2	1.1	1.3	1.6	1.2	1.5	>1	3.3	>1	6.3	2.0	2.3	1.8	2.0
CZ11	PG&E	3.6	1.9	2.1	1.1	2.2	1.6	2.0	1.5	1.1	2.6	1.5	3.6	3.2	2.4	2.8	2.1
CZ12	PG&E	3.5	1.9	2.1	1.1	2.2	1.6	2.0	1.5	0.9	2.5	1.2	3.2	3.1	2.4	2.7	2.1
CZ12-2	SMUD	1.4	1.9	0.8	1.1	1.1	1.6	1.04	1.5	>1	2.5	>1	3.2	1.9	2.4	1.6	2.1
CZ13	PG&E	3.5	1.8	2.0	1.1	2.2	1.5	2.0	1.4	1.1	2.5	1.5	3.6	3.1	2.3	2.7	2.0
CZ14	SDG&E	3.4	2.3	2.0	1.3	2.2	1.9	2.0	1.7	>1	2.3	>1	3.1	3.6	2.8	3.2	2.5
CZ14-2	SCE	1.9	2.3	1.1	1.3	1.3	1.9	1.2	1.7	>1	2.3	>1	3.1	2.2	2.8	1.9	2.5
CZ15	SCE	1.8	2.1	1.1	1.2	1.2	1.7	1.1	1.6	>1	7.5	>1	>1	1.8	2.4	1.6	2.1
CZ16	PG&E	3.9	2.0	2.3	1.1	2.3	1.6	2.1	1.5	0.3	0.4	0.4	0.6	2.5	1.8	2.2	1.6
CZ16-2	LA	1.2	2.0	0.7	1.1	0.7	1.6	0.7	1.5	>1	0.4	>1	0.6	1.3	1.8	1.2	1.6

Figure 39. Cost Effectiveness for Medium Retail - PV and Battery

		Mixed Fuel								All-Electric							
	PV	3kW		3kW		90 kW		90 kW		3kW		3kW		90 kW		90 kW	
	Battery	0		5kWh		0		50kWh		0		5kWh		0		50kWh	
CZ	Utility	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV
CZ01	PG&E	2.3	1.5	1.3	0.9	1.8	1.3	1.6	1.2	>1	3.0	>1	2.7	2.5	1.6	2.2	1.5
CZ02	PG&E	3.2	1.8	1.9	1.1	1.9	1.5	1.8	1.5	>1	>1	>1	>1	2.7	2.1	2.3	1.9
CZ03	PG&E	2.7	1.8	1.6	1.1	2.2	1.5	2.0	1.4	>1	>1	>1	>1	3.0	2.1	2.6	1.9
CZ04	PG&E	3.3	1.9	1.9	1.1	2.0	1.6	1.9	1.5	>1	>1	>1	>1	2.7	2.1	2.5	2.0
CZ04-2	CPAU	2.1	1.9	1.2	1.1	1.7	1.6	1.5	1.5	>1	>1	>1	>1	2.4	2.1	2.1	2.0
CZ05	PG&E	2.8	1.9	1.6	1.1	2.3	1.6	2.0	1.5	>1	>1	>1	>1	3.2	2.1	2.7	2.0
CZ05-2	SCG	2.8	1.9	1.6	1.1	2.3	1.6	2.0	1.5	>1	>1	>1	>1	3.7	1.9	3.2	1.6
CZ06	SCE	2.0	1.9	1.2	1.1	1.2	1.6	1.1	1.5	>1	>1	>1	>1	1.7	2.2	1.5	2.0
CZ06-2	LA	1.3	1.9	0.7	1.1	0.7	1.6	0.6	1.5	>1	>1	>1	>1	1.01	2.2	0.9	2.0
CZ07	SDG&E	4.0	2.0	2.4	1.2	1.5	1.6	1.6	1.6	>1	>1	>1	>1	2.4	2.3	2.3	2.1
CZ08	SCE	2.1	2.0	1.2	1.2	1.2	1.7	1.1	1.6	>1	>1	>1	>1	1.7	2.4	1.5	2.1
CZ08-2	LA	1.3	2.0	0.8	1.2	0.7	1.7	0.6	1.6	>1	>1	>1	>1	1.01	2.4	0.9	2.1
CZ09	SCE	2.0	2.0	1.2	1.2	1.2	1.7	1.1	1.5	>1	>1	>1	>1	1.8	2.4	1.6	2.1
CZ09-2	LA	1.2	2.0	0.7	1.2	0.7	1.7	0.7	1.5	>1	>1	>1	>1	1.1	2.4	0.99	2.1
CZ10	SDG&E	3.8	2.0	2.2	1.2	1.7	1.6	1.7	1.5	>1	>1	>1	>1	2.6	2.3	2.5	2.0
CZ10-2	SCE	2.0	2.0	1.2	1.2	1.2	1.6	1.1	1.5	>1	>1	>1	>1	1.8	2.3	1.6	2.0
CZ11	PG&E	2.8	1.9	1.6	1.1	1.9	1.6	1.8	1.5	>1	>1	>1	>1	2.7	2.3	2.5	2.1
CZ12	PG&E	3.0	1.9	1.7	1.1	1.9	1.6	1.8	1.5	>1	>1	>1	>1	2.7	2.3	2.5	2.1
CZ12-2	SMUD	1.5	1.9	0.9	1.1	1.1	1.6	0.997	1.5	>1	>1	>1	>1	1.7	2.3	1.4	2.1
CZ13	PG&E	3.0	1.9	1.7	1.1	1.9	1.6	1.8	1.4	>1	>1	>1	>1	2.7	2.2	2.4	1.9
CZ14	SDG&E	3.5	2.2	2.1	1.3	1.6	1.8	1.5	1.6	>1	>1	>1	>1	2.5	2.6	2.2	2.2
CZ14-2	SCE	1.8	2.2	1.1	1.3	1.2	1.8	1.1	1.6	>1	>1	>1	>1	1.7	2.6	1.5	2.2
CZ15	SCE	1.9	2.0	1.1	1.2	1.1	1.7	1.02	1.5	>1	>1	>1	>1	1.7	2.4	1.5	2.1
CZ16	PG&E	3.7	2.0	2.1	1.2	2.1	1.7	1.9	1.6	0.6	0.5	0.5	0.4	2.7	2.0	2.3	1.8
CZ16-2	LA	1.3	2.0	0.7	1.2	0.7	1.7	0.6	1.6	>1	0.5	>1	0.4	1.2	2.0	1.0	1.8

Figure 40. Cost Effectiveness for Small Hotel - PV and Battery

CZ		Mixed Fuel								All-Electric							
	PV	3kW		3kW		80kW		80kW		3kW		3kW		80kW		80kW	
	Battery	0		5kWh		0		50kWh		0		5kWh		0		50kWh	
CZ	Utility	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV	On-Bill	TDV
CZ01	PG&E	2.3	1.5	1.3	0.9	1.9	1.2	1.6	1.1	2.3	>1	2.3	>1	4.8	>1	4.7	>1
CZ02	PG&E	2.3	1.9	1.3	1.1	1.8	1.5	1.6	1.4	5.6	>1	5.6	>1	>1	>1	>1	>1
CZ03	PG&E	2.7	1.8	1.6	1.05	2.3	1.5	1.9	1.4	4.2	>1	4.2	>1	>1	>1	>1	>1
CZ04	PG&E	2.4	1.9	1.4	1.1	1.8	1.6	1.6	1.5	6.2	>1	6.2	>1	>1	>1	>1	>1
CZ04-2	CPAU	2.1	1.9	1.2	1.1	1.7	1.6	1.5	1.5	>1	>1	>1	>1	>1	>1	>1	>1
CZ05	PG&E	2.9	1.9	1.7	1.1	2.4	1.6	2.0	1.5	3.9	>1	3.9	>1	>1	>1	>1	>1
CZ05-2	SCG	2.9	1.9	1.7	1.1	2.4	1.6	2.0	1.5	>1	>1	>1	>1	>1	>1	>1	>1
CZ06	SCE	1.8	1.9	1.1	1.1	1.1	1.6	0.9	1.4	>1	>1	>1	>1	>1	>1	>1	>1
CZ06-2	LA	1.1	1.9	0.7	1.1	0.7	1.6	0.6	1.4	>1	>1	>1	>1	>1	>1	>1	>1
CZ07	SDG&E	2.6	2.0	1.5	1.1	1.4	1.6	1.3	1.5	>1	>1	>1	>1	>1	>1	>1	>1
CZ08	SCE	1.9	2.0	1.1	1.2	1.2	1.7	1.0	1.5	>1	>1	>1	>1	>1	>1	>1	>1
CZ08-2	LA	1.2	2.0	0.7	1.2	0.7	1.7	0.6	1.5	>1	>1	>1	>1	>1	>1	>1	>1
CZ09	SCE	1.9	1.9	1.1	1.1	1.2	1.6	0.997	1.4	>1	>1	>1	>1	>1	>1	>1	>1
CZ09-2	LA	1.1	1.9	0.7	1.1	0.7	1.6	0.6	1.4	>1	>1	>1	>1	>1	>1	>1	>1
CZ10	SDG&E	2.9	1.9	1.7	1.1	1.5	1.6	1.4	1.4	8.2	>1	8.2	>1	>1	>1	>1	>1
CZ10-2	SCE	1.7	1.9	0.99	1.1	1.2	1.6	0.99	1.4	>1	>1	>1	>1	>1	>1	>1	>1
CZ11	PG&E	2.6	1.9	1.5	1.1	1.8	1.6	1.5	1.4	7.6	>1	7.6	>1	>1	>1	>1	>1
CZ12	PG&E	2.7	1.9	1.6	1.1	2.3	1.6	1.9	1.4	4.0	>1	4.0	>1	>1	>1	>1	>1
CZ12-2	SMUD	1.4	1.9	0.8	1.1	1.1	1.6	0.95	1.4	>1	>1	>1	>1	>1	>1	>1	>1
CZ13	PG&E	2.6	1.8	1.5	1.1	1.8	1.5	1.5	1.4	7.7	>1	7.7	>1	>1	>1	>1	>1
CZ14	SDG&E	3.0	2.2	1.7	1.3	1.7	1.8	1.5	1.6	4.2	>1	4.2	>1	>1	>1	>1	>1
CZ14-2	SCE	1.8	2.2	1.1	1.3	1.3	1.8	1.1	1.6	>1	>1	>1	>1	>1	>1	>1	>1
CZ15	SCE	1.7	2.0	1.002	1.2	1.2	1.7	1.003	1.4	>1	>1	>1	>1	>1	>1	>1	>1
CZ16	PG&E	2.7	2.0	1.6	1.2	1.9	1.6	1.7	1.5	2.1	5.7	2.1	5.6	5.8	>1	5.8	>1
CZ16-2	LA	1.02	2.0	0.6	1.2	0.6	1.6	0.6	1.5	>1	5.7	>1	5.6	>1	>1	>1	>1

5 Summary, Conclusions, and Further Considerations

The Reach Codes Team developed packages of energy efficiency measures as well as packages combining energy efficiency with PV generation and battery storage systems, 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, cost assumptions, energy escalation rates, or utility tariffs are likely to change results.

5.1 Summary

Figure 41 through Figure 43 summarize results for each prototype and depict the 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 Code Team highlighted cells meeting these two requirements to help clarify the upper boundary for potential reach code policies:

- 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 either depict a negative compliance margin or a package that was not cost effective using either the On-Bill or TDV approach.

For more detail on the results in the Figures, please refer to *Section 4 Results*. As described in Section 4.4, PV-only and PV+Battery packages in the mixed-fuel building were found to be cost effective across all prototypes, climate zones, and packages using the TDV approach, and results are not reiterated in the following figures.

Figure 41. Medium Office Summary of Compliance Margin and Cost Effectiveness

CZ	Utility	Mixed Fuel			All Electric			
		EE	EE + PV + B	HE	Fed Code	EE	EE + PV + B	HE
CZ01	PG&E	18%	18%	3%	-15%	7%	7%	-14%
CZ02	PG&E	17%	17%	4%	-7%	10%	10%	-5%
CZ03	PG&E	20%	20%	3%	-7%	16%	16%	-6%
CZ04	PG&E	14%	14%	5%	-6%	9%	9%	-3%
CZ04-2	CPAU	14%	14%	5%	-6%	9%	9%	-3%
CZ05	PG&E	18%	18%	4%	-8%	12%	12%	-6%
CZ05-2	SCG	18%	18%	4%	NA	NA	NA	NA
CZ06	SCE	20%	20%	3%	-4%	18%	18%	-2%
CZ06-2	LADWP	20%	20%	3%	-4%	18%	18%	-2%
CZ07	SDG&E	20%	20%	4%	-2%	20%	20%	1%
CZ08	SCE	18%	18%	4%	-2%	18%	18%	1%
CZ08-2	LADWP	18%	18%	4%	-2%	18%	18%	1%
CZ09	SCE	16%	16%	4%	-2%	15%	15%	2%
CZ09-2	LADWP	16%	16%	4%	-2%	15%	15%	2%
CZ10	SDG&E	17%	17%	4%	-4%	13%	13%	-1%
CZ10-2	SCE	17%	17%	4%	-4%	13%	13%	-1%
CZ11	PG&E	13%	13%	5%	-4%	10%	10%	0%
CZ12	PG&E	14%	14%	5%	-5%	10%	10%	-1%
CZ12-2	SMUD	14%	14%	5%	-5%	10%	10%	-1%
CZ13	PG&E	13%	13%	5%	-4%	9%	9%	0%
CZ14	SDG&E	14%	14%	5%	-5%	9%	9%	-1%
CZ14-2	SCE	14%	14%	5%	-5%	9%	9%	-1%
CZ15	SCE	12%	12%	5%	-2%	10%	10%	3%
CZ16	PG&E	14%	14%	5%	-27%	-15%	-15%	-26%
CZ16-2	LADWP	14%	14%	5%	-27%	-15%	-15%	-26%

Figure 42. Medium Retail Summary of Compliance Margin and Cost Effectiveness

CZ	Utility	Mixed Fuel			All Electric			
		EE	EE + PV + B	HE	Fed Code	EE	EE + PV + B	HE
CZ01	PG&E	18%	18%	2%	-4.1%	15%	15%	-2%
CZ02	PG&E	13%	13%	3%	-1.0%	13%	13%	3%
CZ03	PG&E	16%	16%	2%	-0.4%	16%	16%	2%
CZ04	PG&E	14%	14%	3%	-0.1%	14%	14%	3%
CZ04-2	CPAU	14%	14%	3%	-0.1%	14%	14%	3%
CZ05	PG&E	16%	16%	1%	-1.2%	15%	15%	1%
CZ05-2	SCG	16%	16%	1%	NA	NA	NA	NA
CZ06	SCE	10%	10%	3%	0.5%	11%	11%	3%
CZ06-2	LADWP	10%	10%	3%	0.5%	11%	11%	3%
CZ07	SDG&E	13%	13%	2%	0.3%	13%	13%	3%
CZ08	SCE	10%	10%	3%	0.4%	10%	10%	4%
CZ08-2	LADWP	10%	10%	3%	0.4%	10%	10%	4%
CZ09	SCE	10%	10%	4%	0.4%	10%	10%	4%
CZ09-2	LADWP	10%	10%	4%	0.4%	10%	10%	4%
CZ10	SDG&E	12%	12%	4%	0.1%	12%	12%	4%
CZ10-2	SCE	12%	12%	4%	0.1%	12%	12%	4%
CZ11	PG&E	13%	13%	4%	0.5%	12%	12%	5%
CZ12	PG&E	13%	13%	4%	-0.1%	12%	12%	4%
CZ12-2	SMUD	13%	13%	4%	-0.1%	12%	12%	4%
CZ13	PG&E	15%	15%	4%	-0.4%	14%	14%	4%
CZ14	SDG&E	13%	13%	4%	0.7%	15%	15%	5%
CZ14-2	SCE	13%	13%	4%	0.7%	15%	15%	5%
CZ15	SCE	12%	12%	5%	0.9%	12%	12%	6%
CZ16	PG&E	13%	13%	3%	-12.2%	3%	3%	-8%
CZ16-2	LADWP	13%	13%	3%	-12.2%	3%	3%	-8%

Figure 43. Small Hotel Summary of Compliance Margin and Cost Effectiveness

CZ	Utility	Mixed Fuel			All Electric			
		EE	EE + PV + B	HE	Fed Code	EE	EE + PV + B	HE
CZ01	PG&E	9%	9%	2%	-28%	1%	1%	-24%
CZ02	PG&E	7%	7%	3%	-12%	4%	4%	-11%
CZ03	PG&E	10%	10%	2%	-14%	6%	6%	-14%
CZ04	PG&E	6%	6%	2%	-13%	0.2%	0.2%	-13%
CZ04-2	CPAU	6%	6%	2%	-13%	0.2%	0.2%	-13%
CZ05	PG&E	9%	9%	2%	-15%	5%	5%	-15%
CZ05-2	SCG	9%	9%	2%	NA	NA	NA	NA
CZ06	SCE	8%	8%	2%	-5%	7%	7%	-15%
CZ06-2	LADWP	8%	8%	2%	-5%	7%	7%	-15%
CZ07	SDG&E	8%	8%	2%	-7%	7%	7%	-7%
CZ08	SCE	7%	7%	2%	-6%	3%	3%	-6%
CZ08-2	LADWP	7%	7%	2%	-6%	3%	3%	-6%
CZ09	SCE	6%	6%	3%	-6%	2%	2%	-4%
CZ09-2	LADWP	6%	6%	3%	-6%	2%	2%	-4%
CZ10	SDG&E	5%	5%	4%	-8%	2%	2%	-5%
CZ10-2	SCE	5%	5%	4%	-8%	2%	2%	-5%
CZ11	PG&E	4%	4%	4%	-10%	1%	1%	-7%
CZ12	PG&E	5%	5%	4%	-10%	2%	2%	-9%
CZ12-2	SMUD	5%	5%	4%	-10%	2%	2%	-9%
CZ13	PG&E	4%	4%	3%	-10%	0.3%	0.3%	-7%
CZ14	SDG&E	4%	4%	4%	-11%	0.1%	0.1%	-7%
CZ14-2	SCE	4%	4%	4%	-11%	0.1%	0.1%	-7%
CZ15	SCE	3%	3%	5%	-4%	2%	2%	0.04%
CZ16	PG&E	6%	6%	3%	-50%	-14%	-14%	-39%
CZ16-2	LADWP	6%	6%	3%	-50%	-14%	-14%	-39%

5.2 Conclusions and Further Considerations

Findings are specific to the scenarios analyzed under this specific methodology, and largely pertain to office, retail, and hotel-type occupancies. Nonresidential buildings constitute a wide variety of occupancy profiles and process loads, making findings challenging to generalize across multiple building types.

Findings indicate the following overall conclusions:

1. This study assumed that electrifying space heating and service water heating could eliminate natural gas infrastructure alone, because these were the only gas end-uses included the prototypes. Avoiding the installation of natural gas infrastructure results in significant cost savings and is a primary factor toward cost-effective outcomes in all-electric designs, even with necessary increases in electrical capacity.
2. There is ample opportunity for cost effective energy efficiency improvements, as demonstrated by the compliance margins achieved in many of the efficiency-only and efficiency + PV packages. Though much of the energy savings are attributable to lighting measures, efficiency measures selected for these prototypes are confined to the building systems that can be modeled. There is

likely further opportunity for energy savings through measures that cannot be currently demonstrated in compliance software, such as high-performance control sequences or variable speed parallel fan powered boxes.

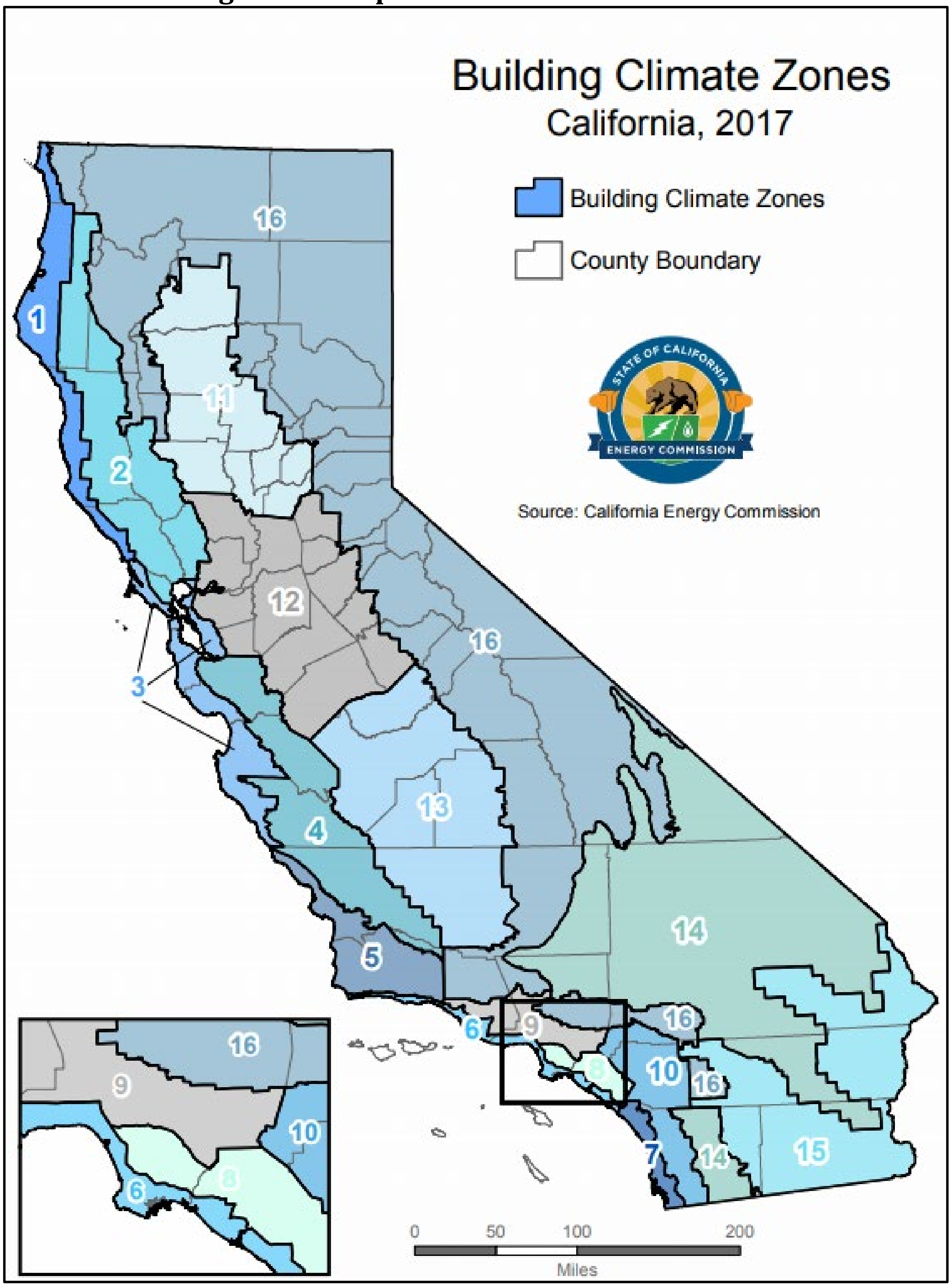
3. High efficiency appliances triggering federal preemption do not achieve as high compliance margins as the other efficiency measures analyzed in this study. Cost effectiveness appears to be dependent on the system type and building type. Nonetheless, specifying high efficiency equipment will always be a key feature in integrated design.
4. Regarding the Small Hotel prototype:
    a. The Small Hotel presents a challenging prototype to cost-effectively exceed the state's energy performance budget without efficiency measures. The Reach Code Team is uncertain of the precision of the results due to the inability to directly model either drain water heat recovery or a central heat pump water heater with a recirculation loop.
    b. Hotel results may be applicable to high-rise (4 or more stories) multifamily buildings. Both hotel and multifamily buildings have the same or similar mandatory and prescriptive compliance options for hot water systems, lighting, and envelope. Furthermore, the Alternate Calculation Method Reference Manual specifies the same baseline HVAC system for both building types.
    c. Hotel compliance margins were the lowest among the three building types analyzed, and thus the most conservative performance thresholds applicable to other nonresidential buildings not analyzed in this study. As stated previously, the varying occupancy and energy profiles of nonresidential buildings makes challenging to directly apply these results across all buildings.
5. Many all-electric and solar PV packages demonstrated greater GHG reductions than their mixed-fuel counterparts, contrary to TDV-based performance, suggesting a misalignment among the TDV metric and California's long-term GHG-reduction goals. The Energy Commission has indicated that they are aware of this issue and are seeking to address it.
6. Changes to the Nonresidential Alternative Calculation Method (ACM) Reference Manual can drastically impact results. Two examples include:
    a. When performance modeling residential buildings, the Standard Design is electric if the Proposed Design is electric, which removes TDV-related penalties and associated negative compliance margins. This essentially allows for a compliance pathway for all-electric residential buildings. If nonresidential buildings were treated in the same way, all-electric cost effectiveness using the TDV approach would improve.
    b. The baseline mixed-fuel system for a hotel includes a furnace in each guest room, which carries substantial plumbing costs and labor costs for assembly. A change in the baseline system would lead to different base case costs and different cost effectiveness outcomes.
7. All-electric federal code-minimum packages appear to be cost effective, largely due to avoided natural gas infrastructure, but in most cases do not comply with the Energy Commission's minimum performance budget (as described in item 7a above). For most cases it appears that adding cost-effective efficiency measures achieves compliance. All-electric nonresidential projects can leverage the initial cost savings of avoiding natural gas infrastructure by adding energy efficiency measures that would not be cost effective independently.

6 Appendices

6.1 Map of California Climate Zones

Climate zone geographical boundaries are depicted in Figure 44. The map in Figure 44 along with a zip-code search directory is available at:
https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html

Figure 44. Map of California Climate Zones



6.2 Lighting Efficiency Measures

Figure 45 details the applicability and impact of each lighting efficiency measure by prototype and space function and includes the resulting LPD that is modeled as the proposed by building type and by space function.

Figure 45. Impact of Lighting Measures on Proposed LPDs by Space Function

	Baseline	Impact				Modeled Proposed
Space Function	LPD (W/ft2)	Interior Lighting Reduced LPD	Institutional Tuning	Daylight Dimming Plus OFF	Occupant Sensing in Open Office Plan	LPD (W/ft^2)
Medium Office						
Office Area (Open plan office) - Interior	0.65	15%	10%	-	17%	0.429
Office Area (Open plan office) - Perimeter	0.65	15%	5%	10%	30%	0.368
Medium Retail						
Commercial/Industrial Storage (Warehouse)	0.45	10%	5%	-	-	0.386
Main Entry Lobby	0.85	10%	5%	-	-	0.729
Retail Sales Area (Retail Merchandise Sales)	0.95	5%	5%	-	-	0.857
Small Hotel						
Commercial/Industrial Storage (Warehouse)	0.45	10%	5%	-	-	0.386
Convention, Conference, Multipurpose, and Meeting	0.85	10%	5%	-	-	0.729
Corridor Area	0.60	10%	5%	-	-	0.514
Exercise/Fitness Center and Gymnasium Areas	0.50	10%	-	-	-	0.450
Laundry Area	0.45	10%	-	-	-	0.405
Lounge, Breakroom, or Waiting Area	0.65	10%	5%	-	-	0.557
Mechanical	0.40	10%	-	-	-	0.360
Office Area (>250 ft^2)	0.65	10%	5%	-	-	0.557

6.3 Drain Water Heat Recovery Measure Analysis

To support potential DWHR savings in the Small Hotel prototype, the Reach Code Team modeled the drain water heat recovery measure in CBECC-Res 2019 in the all-electric and mixed fuel 6,960 ft2 prototype residential buildings. The Reach Code Team assumed one heat recovery device for every three showers assuming unequal flow to the shower. Based on specifications from three different drain water heat recovery device manufacturers for device effectiveness in hotel applications, the team assumed a heat recovery efficiency of 50 percent.

The Reach Code Team modeled mixed fuel and all-electric residential prototype buildings both with and without heat recovery in each climate zone. Based on these model results, the Reach Code Team determined the percentage savings of domestic water heating energy in terms of gas, electricity, and TDV for mixed fuel and all-electric, in each climate zone. The Reach Code Team then applied the savings percentages to the Small Hotel prototype domestic water heating energy in both the mixed-fuel and all-electric to determine energy savings for the drain water heat recovery measure in the Small Hotel. The Reach Code Team applied volumetric energy rates to estimate on-bill cost impacts from this measure.

6.4 Utility Rate Schedules

The Reach Codes Team used the IOU and POU rates depicted in Figure 46 to determine the On-Bill savings for each prototype.

Figure 46. Utility Tariffs Analyzed Based on Climate Zone – Detailed View

Climate Zones	Electric / Gas Utility	Electricity (Time-of-use)			Natural Gas
		Medium Office	Medium Retail	Small Hotel	All Prototypes
CZ01	PG&E	A-10	A-1	A-1 or A-10	G-NR1
CZ02	PG&E	A-10	A-10	A-1 or A-10	G-NR1
CZ03	PG&E	A-10	A-1 or A-10	A-1 or A-10	G-NR1
CZ04	PG&E	A-10	A-10	A-1 or A-10	G-NR1
CZ04-2	CPAU/PG&E	E-2	E-2	E-2	G-NR1
CZ05	PG&E	A-10	A-1	A-1 or A-10	G-NR1
CZ05-2	PG&E/SCG	A-10	A-1	A-1 or A-10	G-10 (GN-10)
CZ06	SCE/SCG	TOU-GS-2	TOU-GS-2	TOU-GS-2 or TOU-GS-3	G-10 (GN-10)
CZ06	LADWP/SCG	TOU-GS-2	TOU-GS-2	TOU-GS-2 or TOU-GS-3	G-10 (GN-10)
CZ07	SDG&E	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 or TOU-GS-3	G-10 (GN-10)
CZ08-2	LADWP/SCG	A-2 (B)	A-2 (B)	A-2 (B)	G-10 (GN-10)
CZ09	SCE/SCG	TOU-GS-2	TOU-GS-2	TOU-GS-2 or TOU-GS-3	G-10 (GN-10)
CZ09-2	LADWP/SCG	A-2 (B)	A-2 (B)	A-2 (B)	G-10 (GN-10)
CZ10	SCE/SCG	TOU-GS-2	TOU-GS-2	TOU-GS-2	G-10 (GN-10)
CZ10-2	SDG&E	AL-TOU+EECC (AL-TOU)	AL-TOU+EECC (AL-TOU)	AL-TOU+EECC (AL-TOU)	GN-3
CZ11	PG&E	A-10	A-10	A-10	G-NR1
CZ12	PG&E	A-10	A-10	A-1 or A-10	G-NR1
CZ12-2	SMUD/PG&E	GS	GS	GS	G-NR1
CZ13	PG&E	A-10	A-10	A-10	G-NR1
CZ14	SCE/SCG	TOU-GS-3	TOU-GS-3	TOU-GS-3	G-10 (GN-10)
CZ14-2	SDG&E	AL-TOU+EECC (AL-TOU)	AL-TOU+EECC (AL-TOU)	AL-TOU+EECC (AL-TOU)	GN-3
CZ15	SCE/SCG	TOU-GS-3	TOU-GS-2	TOU-GS-2	G-10 (GN-10)
CZ16	PG&E	A-10	A-10	A-1 or A-10	G-NR1
CZ16-2	LADWP/SCG	A-2 (B)	A-2 (B)	A-2 (B)	G-10 (GN-10)

6.5 Mixed Fuel Baseline Energy Figures

Figures 47 to 49 show the annual electricity and natural gas consumption and cost, compliance TDV, and GHG emissions for each prototype under the mixed fuel design baseline.

Figure 47. Medium Office – Mixed Fuel Baseline

Climate Zone	Utility	Electricity Consumption (kWh)	Natural Gas Consumption (Therms)	Electricity Cost	Natural Gas Cost	Compliance TDV	GHG Emissions (lbs)
Medium Office Mixed Fuel Baseline							
CZ01	PG&E	358,455	4,967	$109,507	$6,506	84	266,893
CZ02	PG&E	404,865	3,868	$130,575	$5,256	122	282,762
CZ03	PG&E	370,147	3,142	$116,478	$4,349	88	251,759
CZ04	PG&E	431,722	3,759	$140,916	$5,144	141	299,993
CZ04-2	CPAU	431,722	3,759	$75,363	$5,144	141	299,993
CZ05	PG&E	400,750	3,240	$131,277	$4,481	106	269,768
CZ05-2	SCG	400,750	3,240	$131,277	$3,683	106	269,768
CZ06	SCE	397,441	2,117	$74,516	$2,718	105	253,571
CZ06-2	LA	397,441	2,117	$44,311	$2,718	105	253,571
CZ07	SDG&E	422,130	950	$164,991	$4,429	118	257,324
CZ08	SCE	431,207	1,219	$79,181	$1,820	132	265,179
CZ08-2	LA	431,207	1,219	$46,750	$1,820	132	265,179
CZ09	SCE	456,487	1,605	$86,190	$2,196	155	287,269
CZ09-2	LA	456,487	1,605	$51,111	$2,196	155	287,269
CZ10	SDG&E	431,337	2,053	$173,713	$5,390	130	272,289
CZ10-2	SCE	431,337	2,053	$80,636	$2,603	130	272,289
CZ11	PG&E	464,676	3,062	$150,520	$4,333	163	310,307
CZ12	PG&E	441,720	3,327	$142,902	$4,647	152	299,824
CZ12-2	SMUD	441,720	3,327	$65,707	$4,647	152	299,824
CZ13	PG&E	471,540	3,063	$150,919	$4,345	161	316,228
CZ14	SDG&E	467,320	3,266	$185,812	$6,448	165	314,258
CZ14-2	SCE	467,320	3,266	$92,071	$3,579	165	314,258
CZ15	SCE	559,655	1,537	$105,388	$2,058	211	347,545
CZ16	PG&E	405,269	6,185	$127,201	$8,056	116	312,684
CZ16-2	LA	405,269	6,185	$43,115	$8,056	116	312,684

Figure 48. Medium Retail – Mixed Fuel Baseline

Climate Zone	Utility	Electricity Consumption (kWh)	Natural Gas Consumption (Therms)	Electricity Cost	Natural Gas Cost	Compliance TDV	GHG Emissions (lbs)
Medium Retail Mixed Fuel Baseline							
CZ01	PG&E	184,234	3,893	$43,188	$5,247	155	156,972
CZ02	PG&E	214,022	2,448	$70,420	$3,572	202	157,236
CZ03	PG&E	199,827	1,868	$47,032	$2,871	165	140,558
CZ04	PG&E	208,704	1,706	$66,980	$2,681	187	143,966
CZ04-2	CPAU	208,704	1,706	$36,037	$2,681	187	143,966
CZ05	PG&E	195,864	1,746	$45,983	$2,697	155	135,849
CZ05-2	SCG	195,864	1,746	$45,983	$2,342	155	135,849
CZ06	SCE	211,123	1,002	$36,585	$1,591	183	135,557
CZ06-2	LA	211,123	1,002	$21,341	$1,591	183	135,557
CZ07	SDG&E	211,808	522	$75,486	$4,055	178	130,436
CZ08	SCE	212,141	793	$36,758	$1,373	190	133,999
CZ08-2	LA	212,141	793	$21,436	$1,373	190	133,999
CZ09	SCE	227,340	970	$40,083	$1,560	218	146,680
CZ09-2	LA	227,340	970	$23,487	$1,560	218	146,680
CZ10	SDG&E	235,465	1,262	$87,730	$4,700	228	154,572
CZ10-2	SCE	235,465	1,262	$41,000	$1,853	228	154,572
CZ11	PG&E	234,560	2,415	$76,670	$3,547	244	170,232
CZ12	PG&E	228,958	2,309	$75,084	$3,426	234	165,133
CZ12-2	SMUD	228,958	2,309	$32,300	$3,426	234	165,133
CZ13	PG&E	242,927	1,983	$81,995	$3,034	258	170,345
CZ14	SDG&E	264,589	1,672	$97,581	$5,059	277	178,507
CZ14-2	SCE	264,589	1,672	$46,217	$2,172	277	178,507
CZ15	SCE	290,060	518	$50,299	$1,083	300	179,423
CZ16	PG&E	212,204	4,304	$67,684	$5,815	197	180,630
CZ16-2	LA	212,204	4,304	$20,783	$5,815	197	180,630

Figure 49. Small Hotel – Mixed Fuel Baseline

Climate Zone	Utility	Electricity Consumption (kWh)	Natural Gas Consumption (Therms)	Electricity Cost	Natural Gas Cost	Compliance TDV	GHG Emissions (lbs)
Small Hotel Mixed Fuel Baseline							
CZ01	PG&E	177,734	16,936	40,778	20,465	110	340,491
CZ02	PG&E	189,319	12,696	53,396	15,664	110	293,056
CZ03	PG&E	183,772	12,341	42,325	15,210	98	284,217
CZ04	PG&E	187,482	11,945	52,118	14,806	106	281,851
CZ04-2	CPAU	187,482	11,945	32,176	14,806	106	281,851
CZ05	PG&E	187,150	11,979	43,182	14,733	98	281,183
CZ05-2	SCG	187,150	11,979	43,182	10,869	98	281,183
CZ06	SCE	191,764	8,931	28,036	8,437	98	244,664
CZ06-2	LA	191,764	8,931	16,636	8,437	98	244,664
CZ07	SDG&E	189,174	8,207	58,203	10,752	90	233,884
CZ08	SCE	190,503	8,372	27,823	7,991	94	236,544
CZ08-2	LA	190,503	8,372	16,555	7,991	94	236,544
CZ09	SCE	198,204	8,421	30,262	8,030	103	242,296
CZ09-2	LA	198,204	8,421	17,951	8,030	103	242,296
CZ10	SDG&E	215,364	8,437	71,713	10,926	122	255,622
CZ10-2	SCE	215,364	8,437	33,736	8,043	122	255,622
CZ11	PG&E	219,852	10,271	63,724	12,882	131	282,232
CZ12	PG&E	199,499	10,422	46,245	13,022	115	270,262
CZ12-2	SMUD	199,499	10,422	26,872	13,022	115	270,262
CZ13	PG&E	226,925	10,048	65,559	12,629	132	284,007
CZ14	SDG&E	226,104	10,075	73,621	12,167	134	283,287
CZ14-2	SCE	226,104	10,075	35,187	9,350	134	283,287
CZ15	SCE	280,595	5,598	42,852	5,777	152	260,378
CZ16	PG&E	191,231	17,618	51,644	21,581	127	358,590
CZ16-2	LA	191,231	17,618	16,029	21,581	127	358,590

6.6 Hotel TDV Cost Effectiveness with Propane Baseline

The Reach Codes Team further analyzed TDV cost effectiveness of the all-electric packages with a mixed-fuel design baseline using propane instead of natural gas. Results for each package are shown in Figure 50. through Figure 53. below.

All electric models compared to a propane baseline have positive compliance margins in all climate zones when compared to results using a natural gas baseline. Compliance margin improvement is roughly 30 percent, which also leads to improved cost effectiveness for the all-electric packages. These outcomes are likely due to the TDV penalty associated with propane when compared to natural gas.

Across packages, TDV cost effectiveness with a propane baseline follows similar trends as the natural gas baseline. Adding efficiency measures increased compliance margins by 3 to 10 percent depending on climate zone, while adding high efficiency HVAC and SHW equipment alone increased compliance margins by smaller margins of about 2 to 4 percent compared to the All-Electric package.

Figure 50. TDV Cost Effectiveness for Small Hotel, Propane Baseline – Package 2 All-Electric Federal Code Minimum

Climate Zone	Compliance Margin (%)	Incremental Package Cost	$-TDV Savings	B/C Ratio (TDV)	NPV (TDV)
CZ01	-4%	($1,271,869)	($28,346)	44.9	$1,243,523
CZ02	27%	($1,272,841)	$170,263	>1	$1,443,104
CZ03	-3%	($1,275,114)	($16,425)	77.6	$1,258,689
CZ04	26%	($1,274,949)	$155,466	>1	$1,430,414
CZ05	27%	($1,275,002)	$154,709	>1	$1,429,710
CZ06	17%	($1,275,143)	$126,212	>1	$1,401,355
CZ07	25%	($1,273,490)	$117,621	>1	$1,391,111
CZ08	24%	($1,271,461)	$122,087	>1	$1,393,548
CZ09	23%	($1,273,259)	$123,525	>1	$1,396,784
CZ10	18%	($1,270,261)	$109,522	>1	$1,379,783
CZ11	19%	($1,271,070)	$129,428	>1	$1,400,498
CZ12	-4%	($1,272,510)	($26,302)	48.4	$1,246,208
CZ13	18%	($1,270,882)	$124,357	>1	$1,395,239
CZ14	17%	($1,271,241)	$117,621	>1	$1,388,861
CZ15	-7%	($1,269,361)	($45,338)	28.0	$1,224,023
CZ16	9%	($1,275,637)	$68,272	>1	$1,343,908

Figure 51. TDV Cost Effectiveness for Small Hotel, Propane Baseline – Package 3A (All-Electric + EE)

Climate Zone	Compliance Margin (%)	Incremental Package Cost	$-TDV Savings	B/C Ratio (TDV)	NPV (TDV)
CZ01	35%	($1,250,898)	$252,831	>1	$1,503,729
CZ02	34%	($1,251,870)	$217,238	>1	$1,469,108
CZ03	37%	($1,254,142)	$218,642	>1	$1,472,784
CZ04	31%	($1,250,769)	$191,393	>1	$1,442,162
CZ05	36%	($1,254,031)	$208,773	>1	$1,462,804
CZ06	25%	($1,250,964)	$159,714	>1	$1,410,677
CZ07	32%	($1,249,311)	$154,111	>1	$1,403,422
CZ08	29%	($1,247,282)	$146,536	>1	$1,393,818
CZ09	27%	($1,249,080)	$146,671	>1	$1,395,751
CZ10	22%	($1,246,081)	$134,477	>1	$1,380,559
CZ11	23%	($1,246,891)	$157,138	>1	$1,404,029
CZ12	27%	($1,248,330)	$167,945	>1	$1,416,276
CZ13	22%	($1,246,703)	$149,270	>1	$1,395,973
CZ14	21%	($1,247,061)	$145,269	>1	$1,392,331
CZ15	14%	($1,245,182)	$93,647	>1	$1,338,829
CZ16	20%	($1,254,665)	$154,035	>1	$1,408,701

Figure 52. TDV Cost Effectiveness for Small Hotel, Propane Baseline – Package 3B (All-Electric + EE + PV)

Climate Zone	Compliance Margin (%)	Incremental Package Cost	$-TDV Savings	B/C Ratio (TDV)	NPV (TDV)
CZ01	35%	($1,043,528)	$511,688	>1	$1,555,215
CZ02	34%	($1,044,500)	$524,460	>1	$1,568,960
CZ03	37%	($1,046,772)	$518,485	>1	$1,565,257
CZ04	31%	($1,043,399)	$505,579	>1	$1,548,978
CZ05	36%	($1,046,660)	$526,668	>1	$1,573,328
CZ06	25%	($1,043,594)	$469,623	>1	$1,513,216
CZ07	32%	($1,041,941)	$471,513	>1	$1,513,454
CZ08	29%	($1,039,912)	$475,973	>1	$1,515,885
CZ09	27%	($1,041,710)	$467,971	>1	$1,509,681
CZ10	22%	($1,038,711)	$454,832	>1	$1,493,543
CZ11	23%	($1,039,521)	$474,844	>1	$1,514,364
CZ12	27%	($1,040,960)	$484,667	>1	$1,525,627
CZ13	22%	($1,039,333)	$454,108	>1	$1,493,441
CZ14	21%	($1,039,691)	$505,398	>1	$1,545,090
CZ15	14%	($1,037,811)	$423,879	>1	$1,461,691
CZ16	20%	($1,047,295)	$480,407	>1	$1,527,702

Figure 53. TDV Cost Effectiveness for Small Hotel, Propane Baseline – Package 3C (All Electric + HE)

Climate Zone	Compliance Margin (%)	Incremental Package Cost	$-TDV Savings	B/C Ratio (TDV)	NPV (TDV)
CZ01	27%	($1,256,423)	$194,975	>1	$1,451,398
CZ02	28%	($1,258,328)	$177,378	>1	$1,435,706
CZ03	28%	($1,263,867)	$164,094	>1	$1,427,961
CZ04	26%	($1,262,963)	$155,314	>1	$1,418,277
CZ05	26%	($1,263,327)	$153,271	>1	$1,416,598
CZ06	17%	($1,263,779)	$122,011	>1	$1,385,790
CZ07	24%	($1,260,844)	$116,751	>1	$1,377,594
CZ08	25%	($1,256,326)	$122,995	>1	$1,379,321
CZ09	24%	($1,260,223)	$128,482	>1	$1,388,706
CZ10	20%	($1,253,181)	$121,595	>1	$1,374,776
CZ11	21%	($1,254,613)	$143,658	>1	$1,398,271
CZ12	23%	($1,257,919)	$142,901	>1	$1,400,820
CZ13	21%	($1,254,386)	$138,625	>1	$1,393,011
CZ14	20%	($1,254,978)	$136,430	>1	$1,391,407
CZ15	14%	($1,251,932)	$96,087	>1	$1,348,019
CZ16	15%	($1,263,534)	$122,011	>1	$1,385,545

6.7 PV-only and PV+Battery-only Cost Effectiveness Results Details

The Reach Code Tea evaluated cost effectiveness of installing a PV system and battery storage in six different measure combinations over a 2019 code-compliant baseline for all climate zones. The baseline for all nonresidential buildings is a mixed-fuel design.

All mixed fuel models are compliant with 2019 Title24, whereas all electric models can show negative compliance. The compliance margin is the same as that of their respective federal minimum design and is not affected by addition of solar PV or battery. These scenarios evaluate the cost effectiveness of PV and/or battery measure individually. The climate zones where all-electric design is not compliant will have the flexibility to ramp up the efficiency of appliance or add another measure to be code compliant, as per package 1B and 3B in main body of the report. The large negative lifecycle costs in all electric packages are due to lower all-electric HVAC system costs and avoided natural gas infrastructure costs. This is commonly applied across all climate zones and packages over any additional costs for PV and battery.

6.7.1 Cost Effectiveness Results – Medium Office

Figure 54 through Figure 61 contain the cost-effectiveness findings for the Medium Office packages. Notable findings for each package include:

- **Mixed-Fuel + 3 kW PV Only:** All packages are cost effective using the On-Bill and TDV approaches.
- **Mixed-Fuel + 3 kW PV + 5 kWh Battery:** The packages are mostly cost effective on a TDV basis except in CZ1. As compared to the 3 kW PV only package, battery reduces cost effectiveness. This package is not cost effective for LADWP and SMUD territories using an On-Bill approach.
- **Mixed-Fuel + PV only:** The packages are less cost effective as compared to 3 kW PV packages in most climate zones. In areas served by LADWP, the B/C ratio is narrowly less than 1 and not cost effective.
- **Mixed-Fuel + PV + 50 kWh Battery:** The packages are cost effective in all climate zones except for in the areas served by LADWP. On-Bill and TDV B/C ratios are slightly lower compared to the PV only package.
- **All-Electric + 3 kW PV:** Packages are on-bill cost effective in ten of sixteen climate zones. Climate zones 1,2,4,12, and 16 were not found to be cost-effective from an on-bill perspective. These zones are within PG&E's service area. Packages are cost effective using TDV in all climate zones except CZ16.
- **All-Electric + 3 kW PV + 5 kWh Battery**: Packages are slightly more cost effective than the previous minimal PV only package. Packages are on-bill cost effective in most climate zones except for 1,2 and 16 from an on-bill perspective. These zones are within PG&E's service area. Packages are cost effective using TDV in all climate zones except CZ16.
- **All-Electric + PV only:** All packages are cost effective and achieve savings using the On-Bill and TDV approaches.

- **All-Electric + PV + 50 kWh Battery**: All packages are cost effective and achieve savings using the On-Bill and TDV approaches. On-Bill and TDV B/C ratios are slightly lower compared to the PV only package.

Figure 54. Cost Effectiveness for Medium Office - Mixed Fuel + 3kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle $-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 3kW PV											
CZ01	PG&E	3,941	0	0.8	$5,566	$15,743	$8,448	2.8	1.5	$10,177	$2,882
CZ02	PG&E	4,785	0	0.9	$5,566	$20,372	$10,500	3.7	1.9	$14,806	$4,934
CZ03	PG&E	4,660	0	0.9	$5,566	$20,603	$9,975	3.7	1.8	$15,037	$4,409
CZ04	PG&E	5,056	0	1.0	$5,566	$20,235	$11,073	3.6	2.0	$14,669	$5,507
CZ04-2	CPAU	5,056	0	1.0	$5,566	$11,945	$11,073	2.1	2.0	$6,379	$5,507
CZ05	PG&E	5,027	0	1.0	$5,566	$23,159	$10,834	4.2	1.9	$17,593	$5,268
CZ06	SCE	4,853	0	0.9	$5,566	$10,968	$10,930	2.0	2.0	$5,402	$5,364
CZ06-2	LADWP	4,853	0	0.9	$5,566	$6,575	$10,930	1.2	2.0	$1,009	$5,364
CZ07	SDG&E	4,960	0	1.0	$5,566	$17,904	$11,025	3.2	2.0	$12,338	$5,459
CZ08	SCE	4,826	0	0.9	$5,566	$10,768	$11,359	1.9	2.0	$5,202	$5,793
CZ08-2	LADWP	4,826	0	0.9	$5,566	$6,503	$11,359	1.2	2.0	$937	$5,793
CZ09	SCE	4,889	0	1.0	$5,566	$10,622	$11,216	1.9	2.0	$5,056	$5,650
CZ09-2	LADWP	4,889	0	1.0	$5,566	$6,217	$11,216	1.1	2.0	$651	$5,650
CZ10	SDG&E	4,826	0	0.9	$5,566	$21,280	$10,787	3.8	1.9	$15,714	$5,221
CZ10-2	SCE	4,826	0	0.9	$5,566	$11,598	$10,787	2.1	1.9	$6,032	$5,221
CZ11	PG&E	4,701	0	0.9	$5,566	$19,869	$10,644	3.6	1.9	$14,303	$5,078
CZ12	PG&E	4,707	0	0.9	$5,566	$19,643	$10,644	3.5	1.9	$14,077	$5,078
CZ12-2	SMUD	4,707	0	0.9	$5,566	$8,005	$10,644	1.4	1.9	$2,439	$5,078
CZ13	PG&E	4,633	0	0.9	$5,566	$19,231	$10,262	3.5	1.8	$13,665	$4,696
CZ14	SDG&E	5,377	0	1.0	$5,566	$18,789	$12,600	3.4	2.3	$13,223	$7,034
CZ14-2	SCE	5,377	0	1.0	$5,566	$10,512	$12,600	1.9	2.3	$4,946	$7,034
CZ15	SCE	5,099	0	1.0	$5,566	$10,109	$11,550	1.8	2.1	$4,543	$5,984
CZ16	PG&E	5,096	0	1.0	$5,566	$21,836	$10,882	3.9	2.0	$16,270	$5,316
CZ16-2	LADWP	5,096	0	1.0	$5,566	$6,501	$10,882	1.2	2.0	$935	$5,316

Figure 55. Cost Effectiveness for Medium Office – Mixed Fuel + 3kW PV + 5 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 3kW PV + 5kWh Battery											
CZ01	PG&E	3,941	0	0.8	$9,520	$15,743	$8,448	1.7	0.9	$6,223	($1,072)
CZ02	PG&E	4,785	0	0.9	$9,520	$20,372	$10,500	2.1	1.1	$10,852	$980
CZ03	PG&E	4,660	0	0.9	$9,520	$20,603	$9,975	2.2	1.0	$11,083	$455
CZ04	PG&E	5,056	0	1.0	$9,520	$20,235	$11,073	2.1	1.2	$10,714	$1,553
CZ04-2	CPAU	5,056	0	1.0	$9,520	$11,945	$11,073	1.3	1.2	$2,425	$1,553
CZ05	PG&E	5,027	0	1.0	$9,520	$23,159	$10,834	2.4	1.1	$13,639	$1,314
CZ06	SCE	4,853	0	0.9	$9,520	$10,968	$10,930	1.2	1.1	$1,448	$1,410
CZ06-2	LADWP	4,853	0	0.9	$9,520	$6,575	$10,930	0.7	1.1	($2,945)	$1,410
CZ07	SDG&E	4,960	0	1.0	$9,520	$17,904	$11,025	1.9	1.2	$8,384	$1,505
CZ08	SCE	4,826	0	0.9	$9,520	$10,768	$11,359	1.1	1.2	$1,248	$1,839
CZ08-2	LADWP	4,826	0	0.9	$9,520	$6,503	$11,359	0.7	1.2	($3,017)	$1,839
CZ09	SCE	4,889	0	1.0	$9,520	$10,622	$11,216	1.1	1.2	$1,102	$1,696
CZ09-2	LADWP	4,889	0	1.0	$9,520	$6,217	$11,216	0.7	1.2	($3,303)	$1,696
CZ10	SDG&E	4,826	0	0.9	$9,520	$21,280	$10,787	2.2	1.1	$11,760	$1,267
CZ10-2	SCE	4,826	0	0.9	$9,520	$11,598	$10,787	1.2	1.1	$2,078	$1,267
CZ11	PG&E	4,701	0	0.9	$9,520	$19,869	$10,644	2.1	1.1	$10,349	$1,123
CZ12	PG&E	4,707	0	0.9	$9,520	$19,643	$10,644	2.1	1.1	$10,123	$1,123
CZ12-2	SMUD	4,707	0	0.9	$9,520	$8,005	$10,644	0.8	1.1	($1,515)	$1,123
CZ13	PG&E	4,633	0	0.9	$9,520	$19,231	$10,262	2.0	1.1	$9,711	$742
CZ14	SDG&E	5,377	0	1.0	$9,520	$18,789	$12,600	2.0	1.3	$9,269	$3,080
CZ14-2	SCE	5,377	0	1.0	$9,520	$10,512	$12,600	1.1	1.3	$992	$3,080
CZ15	SCE	5,099	0	1.0	$9,520	$10,109	$11,550	1.1	1.2	$589	$2,030
CZ16	PG&E	5,096	0	1.0	$9,520	$21,836	$10,882	2.3	1.1	$12,316	$1,362
CZ16-2	LADWP	5,096	0	1.0	$9,520	$6,501	$10,882	0.7	1.1	($3,019)	$1,362

Figure 56. Cost Effectiveness for Medium Office – Mixed Fuel + 135kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel +135kW PV											
CZ01	PG&E	177,340	0	34.3	$302,856	$526,352	$380,399	1.7	1.3	$223,497	$77,544
CZ02	PG&E	215,311	0	41.5	$302,856	$666,050	$471,705	2.2	1.6	$363,194	$168,849
CZ03	PG&E	209,717	0	40.7	$302,856	$645,010	$449,797	2.1	1.5	$342,154	$146,942
CZ04	PG&E	227,535	0	44.0	$302,856	$686,434	$497,431	2.3	1.6	$383,578	$194,575
CZ04-2	CPAU	227,535	0	44.0	$302,856	$537,521	$497,431	1.8	1.6	$234,665	$194,575
CZ05	PG&E	226,195	0	44.1	$302,856	$753,230	$486,596	2.5	1.6	$450,374	$183,741
CZ06	SCE	218,387	0	42.3	$302,856	$401,645	$492,515	1.3	1.6	$98,789	$189,659
CZ06-2	LADWP	218,387	0	42.3	$302,856	$233,909	$492,515	0.8	1.6	($68,947)	$189,659
CZ07	SDG&E	223,185	0	43.3	$302,856	$623,078	$496,667	2.1	1.6	$320,223	$193,811
CZ08	SCE	217,171	0	42.0	$302,856	$389,435	$510,270	1.3	1.7	$86,579	$207,414
CZ08-2	LADWP	217,171	0	42.0	$302,856	$222,066	$510,270	0.7	1.7	($80,790)	$207,414
CZ09	SCE	220,010	0	43.2	$302,856	$387,977	$505,783	1.3	1.7	$85,122	$202,928
CZ09-2	LADWP	220,010	0	43.2	$302,856	$226,516	$505,783	0.7	1.7	($76,340)	$202,928
CZ10	SDG&E	217,148	0	42.5	$302,856	$632,726	$485,451	2.1	1.6	$329,870	$182,595
CZ10-2	SCE	217,148	0	42.5	$302,856	$394,884	$485,451	1.3	1.6	$92,028	$182,595
CZ11	PG&E	211,556	0	40.9	$302,856	$671,691	$478,912	2.2	1.6	$368,835	$176,056
CZ12	PG&E	211,824	0	40.9	$302,856	$653,242	$478,101	2.2	1.6	$350,386	$175,245
CZ12-2	SMUD	211,824	0	40.9	$302,856	$345,255	$478,101	1.1	1.6	$42,399	$175,245
CZ13	PG&E	208,465	0	40.5	$302,856	$651,952	$462,732	2.2	1.5	$349,096	$159,876
CZ14	SDG&E	241,965	0	46.7	$302,856	$659,487	$566,351	2.2	1.9	$356,632	$263,496
CZ14-2	SCE	241,965	0	46.7	$302,856	$401,712	$566,351	1.3	1.9	$98,856	$263,496
CZ15	SCE	229,456	0	43.9	$302,856	$378,095	$520,102	1.2	1.7	$75,239	$217,246
CZ16	PG&E	229,317	0	44.8	$302,856	$707,095	$489,508	2.3	1.6	$404,239	$186,652
CZ16-2	LADWP	229,317	0	44.8	$302,856	$223,057	$489,508	0.7	1.6	($79,799)	$186,652

Figure 57. Cost Effectiveness for Medium Office – Mixed Fuel + 135kW PV + 50 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 135kW PV + 50 kWh Battery											
CZ01	PG&E	176,903	0	35.3	$330,756	$525,948	$381,450	1.6	1.2	$195,192	$50,694
CZ02	PG&E	214,861	0	42.6	$330,756	$665,864	$472,898	2.0	1.4	$335,108	$142,142
CZ03	PG&E	209,255	0	41.8	$330,756	$644,170	$451,611	1.9	1.4	$313,414	$120,855
CZ04	PG&E	227,076	0	45.0	$330,756	$685,605	$502,108	2.1	1.5	$354,849	$171,352
CZ04-2	CPAU	227,076	0	45.0	$330,756	$536,463	$502,108	1.6	1.5	$205,707	$171,352
CZ05	PG&E	225,752	0	45.1	$330,756	$753,558	$487,742	2.3	1.5	$422,803	$156,986
CZ06	SCE	217,939	0	43.4	$330,756	$401,356	$494,042	1.2	1.5	$70,601	$163,286
CZ06-2	LADWP	217,939	0	43.4	$330,756	$233,673	$494,042	0.7	1.5	($97,083)	$163,286
CZ07	SDG&E	222,746	0	44.4	$330,756	$628,383	$498,147	1.9	1.5	$297,627	$167,391
CZ08	SCE	216,724	0	43.1	$330,756	$389,184	$511,511	1.2	1.5	$58,428	$180,755
CZ08-2	LADWP	216,724	0	43.1	$330,756	$221,839	$511,511	0.7	1.5	($108,917)	$180,755
CZ09	SCE	219,563	0	44.2	$330,756	$387,728	$506,929	1.2	1.5	$56,972	$176,173
CZ09-2	LADWP	219,563	0	44.2	$330,756	$226,303	$506,929	0.7	1.5	($104,453)	$176,173
CZ10	SDG&E	216,700	0	43.5	$330,756	$638,040	$486,644	1.9	1.5	$307,284	$155,888
CZ10-2	SCE	216,700	0	43.5	$330,756	$394,633	$486,644	1.2	1.5	$63,877	$155,888
CZ11	PG&E	211,129	0	41.9	$330,756	$670,932	$481,298	2.0	1.5	$340,177	$150,543
CZ12	PG&E	211,386	0	41.9	$330,756	$652,465	$482,826	2.0	1.5	$321,709	$152,070
CZ12-2	SMUD	211,386	0	41.9	$330,756	$344,668	$482,826	1.0	1.5	$13,913	$152,070
CZ13	PG&E	208,045	0	41.5	$330,756	$651,191	$473,280	2.0	1.4	$320,435	$142,524
CZ14	SDG&E	241,502	0	47.7	$330,756	$672,601	$569,454	2.0	1.7	$341,846	$238,698
CZ14-2	SCE	241,502	0	47.7	$330,756	$401,450	$569,454	1.2	1.7	$70,694	$238,698
CZ15	SCE	229,062	0	44.8	$330,756	$377,827	$521,963	1.1	1.6	$47,071	$191,208
CZ16	PG&E	228,825	0	45.9	$330,756	$706,201	$496,190	2.1	1.5	$375,445	$165,434
CZ16-2	LADWP	228,825	0	45.9	$330,756	$222,802	$496,190	0.7	1.5	($107,953)	$165,434

Figure 58. Cost Effectiveness for Medium Office– All-Electric + 3kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 3kW PV											
CZ01	PG&E	-49,716	4967	10.9	($80,523)	($84,765)	($49,972)	0.9	1.6	($4,242)	$30,551
CZ02	PG&E	-44,899	3868	6.0	($66,965)	($83,115)	($30,928)	0.8	2.2	($16,150)	$36,037
CZ03	PG&E	-31,226	3142	6.5	($75,600)	($39,441)	($19,617)	1.9	3.9	$36,159	$55,983
CZ04	PG&E	-43,772	3759	5.7	($62,282)	($70,999)	($29,496)	0.9	2.1	($8,717)	$32,786
CZ04-2	CPAU	-43,772	3759	5.7	($62,282)	($8,050)	($29,496)	7.7	2.1	$54,232	$32,786
CZ05	PG&E	-35,504	3240	5.5	($77,773)	($42,559)	($29,162)	1.8	2.7	$35,214	$48,611
CZ06	SCE	-21,321	2117	4.0	($69,422)	$35,862	($9,641)	>1	7.2	$105,284	$59,781
CZ06-2	LADWP	-21,321	2117	4.0	($69,422)	$32,936	($9,641)	>1	7.2	$102,358	$59,781
CZ07	SDG&E	-7,943	950	1.9	($63,595)	$64,781	($382)	>1	166.6	$128,376	$63,214
CZ08	SCE	-10,854	1219	2.5	($62,043)	$28,651	($1,289)	>1	48.1	$90,694	$60,755
CZ08-2	LADWP	-10,854	1219	2.5	($62,043)	$25,122	($1,289)	>1	48.1	$87,165	$60,755
CZ09	SCE	-14,878	1605	3.3	($56,372)	$31,542	($3,246)	>1	17.4	$87,913	$53,126
CZ09-2	LADWP	-14,878	1605	3.3	($56,372)	$28,145	($3,246)	>1	17.4	$84,517	$53,126
CZ10	SDG&E	-22,588	2053	3.1	($41,171)	$59,752	($12,553)	>1	3.3	$100,924	$28,619
CZ10-2	SCE	-22,588	2053	3.1	($41,171)	$32,039	($12,553)	>1	3.3	$73,211	$28,619
CZ11	PG&E	-35,455	3062	4.5	($57,257)	($53,776)	($22,194)	1.1	2.6	$3,481	$35,063
CZ12	PG&E	-38,704	3327	5.0	($61,613)	($66,808)	($24,819)	0.9	2.5	($5,195)	$36,794
CZ12-2	SMUD	-38,704	3327	5.0	($61,613)	$2,897	($24,819)	>1	2.5	$64,510	$36,794
CZ13	PG&E	-35,016	3063	4.7	($55,996)	($52,159)	($22,146)	1.1	2.5	$3,836	$33,849
CZ14	SDG&E	-38,945	3266	4.5	($58,426)	$24,867	($25,821)	>1	2.3	$83,293	$32,605
CZ14-2	SCE	-38,945	3266	4.5	($58,426)	$15,338	($25,821)	>1	2.3	$73,764	$32,605
CZ15	SCE	-14,818	1537	2.8	($29,445)	$22,852	($3,914)	>1	7.5	$52,298	$25,532
CZ16	PG&E	-88,966	6185	6.6	($57,366)	($193,368)	($139,989)	0.3	0.4	($136,002)	($82,623)
CZ16-2	LADWP	-88,966	6185	6.6	($57,366)	$36,354	($139,989)	>1	0.4	$93,720	($82,623)

Figure 59. Cost Effectiveness for Medium Office – All-Electric + 3kW PV + 5 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 3kW PV + 5 kWh Battery											
CZ01	PG&E	-49,716	4967	10.9	($78,897)	($84,765)	($49,972)	0.9	1.6	($5,868)	$28,925
CZ02	PG&E	-44,899	3868	6.0	($78,897)	($83,115)	($30,928)	0.9	2.6	($4,218)	$47,969
CZ03	PG&E	-31,226	3142	6.5	($78,897)	($39,441)	($19,617)	2.0	4.0	$39,456	$59,280
CZ04	PG&E	-43,772	3759	5.7	($78,897)	($70,999)	($29,496)	1.1	2.7	$7,898	$49,400
CZ04-2	CPAU	-43,772	3759	5.7	($78,897)	($8,050)	($29,496)	9.8	2.7	$70,847	$49,400
CZ05	PG&E	-35,504	3240	5.5	($78,897)	($42,559)	($29,162)	1.9	2.7	$36,338	$49,735
CZ06	SCE	-21,321	2117	4.0	($78,897)	$35,862	($9,641)	>1	8.2	$114,759	$69,256
CZ06-2	LADWP	-21,321	2117	4.0	($78,897)	$32,936	($9,641)	>1	8.2	$111,833	$69,256
CZ07	SDG&E	-7,943	950	1.9	($78,897)	$64,781	($382)	>1	206.6	$143,678	$78,515
CZ08	SCE	-10,854	1219	2.5	($78,897)	$28,651	($1,289)	>1	61.2	$107,548	$77,608
CZ08-2	LADWP	-10,854	1219	2.5	($78,897)	$25,122	($1,289)	>1	61.2	$104,019	$77,608
CZ09	SCE	-14,878	1605	3.3	($78,897)	$31,542	($3,246)	>1	24.3	$110,439	$75,651
CZ09-2	LADWP	-14,878	1605	3.3	($78,897)	$28,145	($3,246)	>1	24.3	$107,042	$75,651
CZ10	SDG&E	-22,588	2053	3.1	($78,897)	$59,752	($12,553)	>1	6.3	$138,649	$66,344
CZ10-2	SCE	-22,588	2053	3.1	($78,897)	$32,039	($12,553)	>1	6.3	$110,936	$66,344
CZ11	PG&E	-35,455	3062	4.5	($78,897)	($53,776)	($22,194)	1.5	3.6	$25,121	$56,703
CZ12	PG&E	-38,704	3327	5.0	($78,897)	($66,808)	($24,819)	1.2	3.2	$12,089	$54,078
CZ12-2	SMUD	-38,704	3327	5.0	($78,897)	$2,897	($24,819)	>1	3.2	$81,794	$54,078
CZ13	PG&E	-35,016	3063	4.7	($78,897)	($52,159)	($22,146)	1.5	3.6	$26,738	$56,751
CZ14	SDG&E	-38,945	3266	4.5	($78,897)	$24,867	($25,821)	>1	3.1	$103,764	$53,076
CZ14-2	SCE	-38,945	3266	4.5	($78,897)	$15,338	($25,821)	>1	3.1	$94,235	$53,076
CZ15	SCE	-14,818	1537	2.8	($78,897)	$22,852	($3,914)	>1	20.2	$101,749	$74,983
CZ16	PG&E	-88,966	6185	6.6	($78,897)	($193,368)	($139,989)	0.4	0.6	($114,472)	($61,092)
CZ16-2	LADWP	-88,966	6185	6.6	($78,897)	$36,354	($139,989)	>1	0.6	$115,250	($61,092)

Figure 60. Cost Effectiveness for Medium Office – All-Electric + 135kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 135kW PV											
CZ01	PG&E	123,683	4967	44.5	$163,217	$405,731	$321,979	2.5	2.0	$242,514	$158,762
CZ02	PG&E	165,627	3868	46.6	$176,775	$562,528	$430,276	3.2	2.4	$385,753	$253,501
CZ03	PG&E	173,831	3142	46.3	$168,140	$575,864	$420,205	3.4	2.5	$407,725	$252,066
CZ04	PG&E	178,706	3759	48.7	$181,458	$601,431	$456,861	3.3	2.5	$419,973	$275,403
CZ04-2	CPAU	178,706	3759	48.7	$181,458	$517,526	$456,861	2.9	2.5	$336,069	$275,403
CZ05	PG&E	185,664	3240	48.6	$165,967	$664,842	$446,600	4.0	2.7	$498,875	$280,633
CZ06	SCE	192,214	2117	45.3	$174,317	$423,657	$471,944	2.4	2.7	$249,340	$297,626
CZ06-2	LADWP	192,214	2117	45.3	$174,317	$259,270	$471,944	1.5	2.7	$84,953	$297,626
CZ07	SDG&E	210,282	950	44.3	$180,145	$669,979	$485,260	3.7	2.7	$489,834	$305,115
CZ08	SCE	201,491	1219	43.5	$181,696	$407,277	$497,622	2.2	2.7	$225,580	$315,925
CZ08-2	LADWP	201,491	1219	43.5	$181,696	$240,657	$497,622	1.3	2.7	$58,960	$315,925
CZ09	SCE	200,242	1605	45.6	$187,368	$408,922	$491,322	2.2	2.6	$221,554	$303,953
CZ09-2	LADWP	200,242	1605	45.6	$187,368	$248,452	$491,322	1.3	2.6	$61,084	$303,953
CZ10	SDG&E	189,734	2053	44.7	$202,568	$667,551	$462,111	3.3	2.3	$464,982	$259,543
CZ10-2	SCE	189,734	2053	44.7	$202,568	$412,659	$462,111	2.0	2.3	$210,091	$259,543
CZ11	PG&E	171,399	3062	44.5	$186,483	$597,807	$446,074	3.2	2.4	$411,324	$259,592
CZ12	PG&E	168,413	3327	45.0	$182,127	$571,758	$442,638	3.1	2.4	$389,632	$260,511
CZ12-2	SMUD	168,413	3327	45.0	$182,127	$343,602	$442,638	1.9	2.4	$161,475	$260,511
CZ13	PG&E	168,817	3063	44.3	$187,744	$581,964	$430,324	3.1	2.3	$394,220	$242,580
CZ14	SDG&E	197,643	3266	50.1	$185,314	$667,762	$527,930	3.6	2.8	$482,449	$342,616
CZ14-2	SCE	197,643	3266	50.1	$185,314	$408,424	$527,930	2.2	2.8	$223,110	$342,616
CZ15	SCE	209,539	1537	45.7	$214,294	$390,267	$504,638	1.8	2.4	$175,972	$290,343
CZ16	PG&E	135,255	6185	50.4	$186,374	$470,199	$338,637	2.5	1.8	$283,825	$152,263
CZ16-2	LADWP	135,255	6185	50.4	$186,374	$250,807	$338,637	1.3	1.8	$64,433	$152,263

Figure 61. Cost Effectiveness for Medium Office – All-Electric + 135kW PV + 50 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 135kW PV + 50 kWh Battery											
CZ01	PG&E	123,280	4967	45.4	$191,117	$404,994	$323,077	2.1	1.7	$213,877	$131,960
CZ02	PG&E	165,200	3868	47.7	$204,675	$561,747	$431,469	2.7	2.1	$357,072	$226,795
CZ03	PG&E	173,384	3142	47.4	$196,040	$575,043	$422,019	2.9	2.2	$379,003	$225,979
CZ04	PG&E	178,259	3759	49.8	$209,358	$600,621	$461,634	2.9	2.2	$391,263	$252,276
CZ04-2	CPAU	178,259	3759	49.8	$209,358	$516,495	$461,634	2.5	2.2	$307,137	$252,276
CZ05	PG&E	185,229	3240	49.7	$193,867	$664,046	$447,793	3.4	2.3	$470,179	$253,926
CZ06	SCE	191,767	2117	46.5	$202,217	$423,369	$473,519	2.1	2.3	$221,152	$271,301
CZ06-2	LADWP	191,767	2117	46.5	$202,217	$259,033	$473,519	1.3	2.3	$56,816	$271,301
CZ07	SDG&E	209,848	950	45.4	$208,045	$675,307	$486,787	3.2	2.3	$467,262	$278,743
CZ08	SCE	201,047	1219	44.7	$209,596	$407,027	$498,910	1.9	2.4	$197,430	$289,314
CZ08-2	LADWP	201,047	1219	44.7	$209,596	$240,432	$498,910	1.1	2.4	$30,835	$289,314
CZ09	SCE	199,802	1605	46.6	$215,268	$408,676	$492,515	1.9	2.3	$193,408	$277,246
CZ09-2	LADWP	199,802	1605	46.6	$215,268	$248,242	$492,515	1.2	2.3	$32,974	$277,246
CZ10	SDG&E	189,293	2053	45.7	$230,468	$672,867	$463,352	2.9	2.0	$442,399	$232,884
CZ10-2	SCE	189,293	2053	45.7	$230,468	$412,412	$463,352	1.8	2.0	$181,944	$232,884
CZ11	PG&E	170,987	3062	45.5	$214,383	$597,062	$448,509	2.8	2.1	$382,680	$234,126
CZ12	PG&E	167,995	3327	46.0	$210,027	$571,002	$447,411	2.7	2.1	$360,975	$237,384
CZ12-2	SMUD	167,995	3327	46.0	$210,027	$343,043	$447,411	1.6	2.1	$133,017	$237,384
CZ13	PG&E	168,408	3063	45.3	$215,644	$581,225	$440,920	2.7	2.0	$365,580	$225,275
CZ14	SDG&E	197,188	3266	51.2	$213,214	$680,893	$531,080	3.2	2.5	$467,679	$317,866
CZ14-2	SCE	197,188	3266	51.2	$213,214	$408,166	$531,080	1.9	2.5	$194,952	$317,866
CZ15	SCE	209,148	1537	46.6	$242,194	$390,000	$506,499	1.6	2.1	$147,806	$264,305
CZ16	PG&E	134,809	6185	51.4	$214,274	$469,378	$341,978	2.2	1.6	$255,105	$127,704
CZ16-2	LADWP	134,809	6185	51.4	$214,274	$250,580	$341,978	1.2	1.6	$36,306	$127,704

6.7.2 Cost Effectiveness Results – Medium Retail

Figure 62 through Figure 69 contain the cost-effectiveness findings for the Medium Retail packages. Notable findings for each package include:

- **Mixed-Fuel + 3 kW PV:** Packages are cost effective and achieve savings for all climate zones using the On-Bill and TDV approaches.
- **Mixed-Fuel + 3 kW PV + 5 kWh Battery:** The packages are less cost effective as compared to the 3 kW PV only package and not cost effective for LADWP and SMUD service area.
- **Mixed-Fuel + PV only:** Packages achieve positive energy cost savings and are cost effective using the On-Bill approach for all climate zones except for LADWP territory (CZs 6, 8, 9 and 16). Packages achieve positive savings and are cost effective using the TDV approach for all climate zones.
- **Mixed Fuel + PV + 5 kWh Battery:** Adding battery slightly reduces On-Bill B/C ratios but is still cost effective for all climate zones except for LADWP territory. Packages achieve savings and cost effective using the TDV approach for all climate zones.
- **All-Electric + 3 kW PV:** Packages are cost effective using the On-Bill and TDV approach for all climate zones except for CZ16 under PG&E service.
- **All-Electric + 3 kW PV + 5 kWh Battery**: Similar to minimal PV only package, adding battery is cost effective as well using the On-Bill and TDV approach for all climate zones except for CZ16 under PG&E service.
- **All-Electric + PV only:** Packages are cost effective and achieve savings in all climate zones for both the On-Bill and TDV approaches
- **All-Electric + PV + 50 kWh Battery**: Adding battery slightly reduces B/C ratios for both the On-Bill and TDV approaches. Packages are not cost effective for all climate zones except CZ6, CZ8 and CZ9 under LADWP service area.

Figure 62. Cost Effectiveness for Medium Retail – Mixed-Fuel + 3kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 3kW PV											
CZ01	PG&E	3,941	0	0.76	$5,566	$12,616	$8,460	2.3	1.5	$7,050	$2,894
CZ02	PG&E	4,685	0	0.91	$5,566	$17,635	$10,262	3.2	1.8	$12,069	$4,696
CZ03	PG&E	4,733	0	0.92	$5,566	$15,146	$10,152	2.7	1.8	$9,580	$4,586
CZ04	PG&E	4,834	0	0.94	$5,566	$18,519	$10,614	3.3	1.9	$12,953	$5,048
CZ04-2	CPAU	4,834	0	0.94	$5,566	$11,507	$10,614	2.1	1.9	$5,941	$5,048
CZ05	PG&E	4,910	0	0.95	$5,566	$15,641	$10,548	2.8	1.9	$10,075	$4,982
CZ06	SCE	4,769	0	0.93	$5,566	$11,374	$10,724	2.0	1.9	$5,808	$5,158
CZ06-2	LA	4,769	0	0.93	$5,566	$7,069	$10,724	1.3	1.9	$1,503	$5,158
CZ07	SDG&E	4,960	0	0.96	$5,566	$22,452	$11,031	4.0	2.0	$16,886	$5,465
CZ08	SCE	4,826	0	0.93	$5,566	$11,838	$11,339	2.1	2.0	$6,272	$5,773
CZ08-2	LA	4,826	0	0.93	$5,566	$7,342	$11,339	1.3	2.0	$1,776	$5,773
CZ09	SCE	4,889	0	0.96	$5,566	$11,187	$11,229	2.0	2.0	$5,621	$5,663
CZ09-2	LA	4,889	0	0.96	$5,566	$6,728	$11,229	1.2	2.0	$1,162	$5,663
CZ10	SDG&E	4,948	0	0.97	$5,566	$20,999	$10,987	3.8	2.0	$15,433	$5,421
CZ10-2	SCE	4,948	0	0.97	$5,566	$11,384	$10,987	2.0	2.0	$5,818	$5,421
CZ11	PG&E	4,718	0	0.91	$5,566	$15,381	$10,680	2.8	1.9	$9,815	$5,114
CZ12	PG&E	4,707	0	0.91	$5,566	$16,442	$10,614	3.0	1.9	$10,876	$5,048
CZ12-2	SMUD	4,707	0	0.91	$5,566	$8,247	$10,614	1.5	1.9	$2,681	$5,048
CZ13	PG&E	4,750	0	0.92	$5,566	$16,638	$10,592	3.0	1.9	$11,072	$5,026
CZ14	SDG&E	5,258	0	1.01	$5,566	$19,576	$12,218	3.5	2.2	$14,010	$6,652
CZ14-2	SCE	5,258	0	1.01	$5,566	$10,227	$12,218	1.8	2.2	$4,661	$6,652
CZ15	SCE	4,997	0	0.96	$5,566	$10,476	$11,339	1.9	2.0	$4,910	$5,773
CZ16	PG&E	5,336	0	1.04	$5,566	$20,418	$11,361	3.7	2.0	$14,852	$5,795
CZ16-2	LA	5,336	0	1.04	$5,566	$6,987	$11,361	1.3	2.0	$1,421	$5,795

Figure 63. Cost Effectiveness for Medium Retail – Mixed Fuel + 3kW PV + 5 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 3kW PV + 5 kWh Battery											
CZ01	PG&E	3,941	0	0.76	$9,520	$12,616	$8,460	1.3	0.9	$3,096	($1,060)
CZ02	PG&E	4,685	0	0.91	$9,520	$17,635	$10,262	1.9	1.1	$8,115	$742
CZ03	PG&E	4,733	0	0.92	$9,520	$15,146	$10,152	1.6	1.1	$5,626	$632
CZ04	PG&E	4,834	0	0.94	$9,520	$18,519	$10,614	1.9	1.1	$8,999	$1,094
CZ04-2	CPAU	4,834	0	0.94	$9,520	$11,507	$10,614	1.2	1.1	$1,987	$1,094
CZ05	PG&E	4,910	0	0.95	$9,520	$15,641	$10,548	1.6	1.1	$6,120	$1,028
CZ05-2	SCG	4,910	0	0.95	$9,520	$15,641	$10,548	1.6	1.1	$6,120	$1,028
CZ06	SCE	4,769	0	0.93	$9,520	$11,374	$10,724	1.2	1.1	$1,854	$1,204
CZ06-2	LA	4,769	0	0.93	$9,520	$7,069	$10,724	0.7	1.1	($2,452)	$1,204
CZ07	SDG&E	4,960	0	0.96	$9,520	$22,452	$11,031	2.4	1.2	$12,932	$1,511
CZ08	SCE	4,826	0	0.93	$9,520	$11,838	$11,339	1.2	1.2	$2,317	$1,819
CZ08-2	LA	4,826	0	0.93	$9,520	$7,342	$11,339	0.8	1.2	($2,178)	$1,819
CZ09	SCE	4,889	0	0.96	$9,520	$11,187	$11,229	1.2	1.2	$1,667	$1,709
CZ09-2	LA	4,889	0	0.96	$9,520	$6,728	$11,229	0.7	1.2	($2,792)	$1,709
CZ10	SDG&E	4,948	0	0.97	$9,520	$20,999	$10,987	2.2	1.2	$11,479	$1,467
CZ10-2	SCE	4,948	0	0.97	$9,520	$11,384	$10,987	1.2	1.2	$1,863	$1,467
CZ11	PG&E	4,718	0	0.91	$9,520	$15,381	$10,680	1.6	1.1	$5,861	$1,160
CZ12	PG&E	4,707	0	0.91	$9,520	$16,442	$10,614	1.7	1.1	$6,922	$1,094
CZ12-2	SMUD	4,707	0	0.91	$9,520	$8,247	$10,614	0.9	1.1	($1,273)	$1,094
CZ13	PG&E	4,750	0	0.92	$9,520	$16,638	$10,592	1.7	1.1	$7,117	$1,072
CZ14	SDG&E	5,258	0	1.01	$9,520	$19,576	$12,218	2.1	1.3	$10,056	$2,698
CZ14-2	SCE	5,258	0	1.01	$9,520	$10,227	$12,218	1.1	1.3	$707	$2,698
CZ15	SCE	4,997	0	0.96	$9,520	$10,476	$11,339	1.1	1.2	$956	$1,819
CZ16	PG&E	5,336	0	1.04	$9,520	$20,418	$11,361	2.1	1.2	$10,898	$1,841
CZ16-2	LA	5,336	0	1.04	$9,520	$6,987	$11,361	0.7	1.2	($2,533)	$1,841

Figure 64. Cost Effectiveness for Medium Retail – Mixed-Fuel + 110kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 110kW PV											
CZ01	PG&E	144,499	0	27.97	$201,904	$454,462	$309,935	2.3	1.5	$252,558	$108,031
CZ02	PG&E	171,790	0	33.31	$201,904	$477,584	$376,300	2.4	1.9	$275,681	$174,396
CZ03	PG&E	173,534	0	33.55	$201,904	$538,530	$372,146	2.7	1.8	$336,626	$170,243
CZ04	PG&E	177,229	0	34.42	$201,904	$489,934	$389,067	2.4	1.9	$288,030	$187,163
CZ04-2	CPAU	177,229	0	34.42	$201,904	$418,173	$389,067	2.1	1.9	$216,269	$187,163
CZ05	PG&E	180,044	0	34.84	$201,904	$556,787	$386,958	2.8	1.9	$354,883	$185,054
CZ06	SCE	174,855	0	33.92	$201,904	$288,188	$393,198	1.4	1.9	$86,284	$191,295
CZ06-2	LA	174,855	0	33.92	$201,904	$165,538	$393,198	0.8	1.9	($36,366)	$191,295
CZ07	SDG&E	181,854	0	35.32	$201,904	$373,974	$404,713	1.9	2.0	$172,070	$202,809
CZ08	SCE	176,954	0	34.23	$201,904	$284,481	$415,789	1.4	2.1	$82,577	$213,885
CZ08-2	LA	176,954	0	34.23	$201,904	$161,366	$415,789	0.8	2.1	($40,538)	$213,885
CZ09	SCE	179,267	0	35.18	$201,904	$289,050	$412,097	1.4	2.0	$87,146	$210,193
CZ09-2	LA	179,267	0	35.18	$201,904	$168,822	$412,097	0.8	2.0	($33,082)	$210,193
CZ10	SDG&E	181,443	0	35.41	$201,904	$410,310	$402,999	2.0	2.0	$208,406	$201,095
CZ10-2	SCE	181,443	0	35.41	$201,904	$291,236	$402,999	1.4	2.0	$89,332	$201,095
CZ11	PG&E	172,983	0	33.46	$201,904	$464,776	$391,550	2.3	1.9	$262,872	$189,646
CZ12	PG&E	172,597	0	33.33	$201,904	$467,870	$389,573	2.3	1.9	$265,966	$187,669
CZ12-2	SMUD	172,597	0	33.33	$201,904	$267,086	$389,573	1.3	1.9	$65,182	$187,669
CZ13	PG&E	174,151	0	33.81	$201,904	$478,857	$387,968	2.4	1.9	$276,953	$186,065
CZ14	SDG&E	192,789	0	36.97	$201,904	$396,181	$448,268	2.0	2.2	$194,277	$246,364
CZ14-2	SCE	192,789	0	36.97	$201,904	$288,782	$448,268	1.4	2.2	$86,878	$246,364
CZ15	SCE	183,214	0	35.12	$201,904	$277,867	$415,789	1.4	2.1	$75,963	$213,885
CZ16	PG&E	195,665	0	37.97	$201,904	$522,352	$416,558	2.6	2.1	$320,448	$214,654
CZ16-2	LA	195,665	0	37.97	$201,904	$171,802	$416,558	0.9	2.1	($30,101)	$214,654

Figure 65. Cost Effectiveness for Medium Retail – Mixed-Fuel + 110 kW PV + 50 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 110kW PV + 50 kWh Battery											
CZ01	PG&E	143,423	0	29.48	$229,804	$452,119	$324,373	2.0	1.4	$222,315	$94,569
CZ02	PG&E	170,542	0	35.14	$229,804	$486,704	$398,363	2.1	1.7	$256,900	$168,559
CZ03	PG&E	172,266	0	35.66	$229,804	$535,974	$395,374	2.3	1.7	$306,170	$165,570
CZ04	PG&E	175,940	0	36.32	$229,804	$525,788	$422,579	2.3	1.8	$295,984	$192,775
CZ04-2	CPAU	175,940	0	36.32	$229,804	$416,019	$422,579	1.8	1.8	$186,216	$192,775
CZ05	PG&E	178,728	0	36.91	$229,804	$554,968	$409,086	2.4	1.8	$325,164	$179,283
CZ06	SCE	173,567	0	35.99	$229,804	$290,599	$412,690	1.3	1.8	$60,795	$182,886
CZ06-2	LA	173,567	0	35.99	$229,804	$169,786	$412,690	0.7	1.8	($60,018)	$182,886
CZ07	SDG&E	180,508	0	37.61	$229,804	$425,793	$427,040	1.9	1.9	$195,989	$197,236
CZ08	SCE	175,616	0	36.29	$229,804	$296,318	$434,687	1.3	1.9	$66,514	$204,883
CZ08-2	LA	175,616	0	36.29	$229,804	$170,489	$434,687	0.7	1.9	($59,315)	$204,883
CZ09	SCE	177,966	0	36.74	$229,804	$300,540	$421,195	1.3	1.8	$70,736	$191,391
CZ09-2	LA	177,966	0	36.74	$229,804	$178,852	$421,195	0.8	1.8	($50,952)	$191,391
CZ10	SDG&E	180,248	0	36.91	$229,804	$459,486	$410,537	2.0	1.8	$229,683	$180,733
CZ10-2	SCE	180,248	0	36.91	$229,804	$301,219	$410,537	1.3	1.8	$71,415	$180,733
CZ11	PG&E	171,779	0	34.85	$229,804	$490,245	$417,679	2.1	1.8	$260,442	$187,875
CZ12	PG&E	171,392	0	34.77	$229,804	$497,363	$417,371	2.2	1.8	$267,559	$187,567
CZ12-2	SMUD	171,392	0	34.77	$229,804	$273,783	$417,371	1.2	1.8	$43,979	$187,567
CZ13	PG&E	173,052	0	34.97	$229,804	$488,196	$397,791	2.1	1.7	$258,392	$167,987
CZ14	SDG&E	191,703	0	38.31	$229,804	$420,241	$452,641	1.8	2.0	$190,437	$222,837
CZ14-2	SCE	191,703	0	38.31	$229,804	$294,010	$452,641	1.3	2.0	$64,206	$222,837
CZ15	SCE	182,299	0	36.01	$229,804	$279,036	$416,382	1.2	1.8	$49,232	$186,578
CZ16	PG&E	194,293	0	40.00	$229,804	$535,137	$432,951	2.3	1.9	$305,333	$203,147
CZ16-2	LA	194,293	0	40.00	$229,804	$175,573	$432,951	0.8	1.9	($54,231)	$203,147

Figure 66. Cost Effectiveness for Medium Retail – All-Electric + 3kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 3kW PV											
CZ01	PG&E	-25,214	3893	14.61	($16,318)	$4,288	($5,450)	>1	3.0	$20,606	$10,868
CZ02	PG&E	-17,101	2448	8.40	($20,734)	$859	$5,779	>1	>1	$21,593	$26,513
CZ03	PG&E	-9,851	1868	7.18	($17,381)	$15,418	$8,702	>1	>1	$32,799	$26,083
CZ04	PG&E	-9,353	1706	6.24	($16,166)	$9,110	$10,394	>1	>1	$25,276	$26,560
CZ04-2	CPAU	-9,353	1706	6.24	($16,166)	$24,000	$10,394	>1	>1	$40,166	$26,560
CZ05	PG&E	-9,423	1746	6.42	($18,776)	$14,076	$6,351	>1	>1	$32,852	$25,127
CZ06	SCE	-2,759	1002	4.24	($15,032)	$29,710	$12,592	>1	>1	$44,741	$27,623
CZ06-2	LA	-2,759	1002	4.24	($15,032)	$26,292	$12,592	>1	>1	$41,324	$27,623
CZ07	SDG&E	1,148	522	2.72	($17,032)	$76,810	$12,350	>1	>1	$93,842	$29,382
CZ08	SCE	-979	793	3.64	($20,192)	$28,576	$13,185	>1	>1	$48,768	$33,377
CZ08-2	LA	-979	793	3.64	($20,192)	$24,475	$13,185	>1	>1	$44,667	$33,377
CZ09	SCE	-2,352	970	4.28	($25,383)	$29,776	$13,207	>1	>1	$55,159	$38,590
CZ09-2	LA	-2,352	970	4.28	($25,383)	$25,823	$13,207	>1	>1	$51,207	$38,590
CZ10	SDG&E	-5,388	1262	4.95	($20,541)	$75,458	$11,493	>1	>1	$95,999	$32,034
CZ10-2	SCE	-5,388	1262	4.95	($20,541)	$32,394	$11,493	>1	>1	$52,936	$32,034
CZ11	PG&E	-14,533	2415	8.86	($25,471)	$7,618	$13,295	>1	>1	$33,090	$38,766
CZ12	PG&E	-14,764	2309	8.19	($25,774)	$2,210	$10,152	>1	>1	$27,984	$35,926
CZ12-2	SMUD	-14,764	2309	8.19	($25,774)	$21,215	$10,152	>1	>1	$46,988	$35,926
CZ13	PG&E	-12,069	1983	7.08	($21,428)	$5,647	$8,570	>1	>1	$27,075	$29,998
CZ14	SDG&E	-7,950	1672	6.45	($19,926)	$60,412	$16,679	>1	>1	$80,338	$36,605
CZ14-2	SCE	-7,950	1672	6.45	($19,926)	$28,631	$16,679	>1	>1	$48,557	$36,605
CZ15	SCE	2,534	518	3.10	($22,813)	$27,271	$17,162	>1	>1	$50,084	$39,976
CZ16	PG&E	-36,081	4304	14.26	($19,041)	($30,111)	($41,181)	0.6	0.5	($11,070)	($22,140)
CZ16-2	LA	-36,081	4304	14.26	($19,041)	$45,706	($41,181)	>1	0.5	$64,747	($22,140)

Figure 67. Cost Effectiveness for Medium Retail – All-Electric + 3kW PV + 5 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 3kW PV + 5 kWh Battery											
CZ01	PG&E	-25,214	3893	14.61	($14,692)	$4,288	($5,450)	>1	2.7	$18,980	$9,242
CZ02	PG&E	-17,101	2448	8.40	($14,692)	$859	$5,779	>1	>1	$15,551	$20,472
CZ03	PG&E	-9,851	1868	7.18	($14,692)	$15,418	$8,702	>1	>1	$30,110	$23,394
CZ04	PG&E	-9,353	1706	6.24	($14,692)	$9,110	$10,394	>1	>1	$23,802	$25,086
CZ04-2	CPAU	-9,353	1706	6.24	($14,692)	$24,000	$10,394	>1	>1	$38,693	$25,086
CZ05	PG&E	-9,423	1746	6.42	($14,692)	$14,076	$6,351	>1	>1	$28,768	$21,043
CZ06	SCE	-2,759	1002	4.24	($14,692)	$29,710	$12,592	>1	>1	$44,402	$27,284
CZ06-2	LA	-2,759	1002	4.24	($14,692)	$26,292	$12,592	>1	>1	$40,984	$27,284
CZ07	SDG&E	1,148	522	2.72	($14,692)	$76,810	$12,350	>1	>1	$91,502	$27,042
CZ08	SCE	-979	793	3.64	($14,692)	$28,576	$13,185	>1	>1	$43,268	$27,877
CZ08-2	LA	-979	793	3.64	($14,692)	$24,475	$13,185	>1	>1	$39,167	$27,877
CZ09	SCE	-2,352	970	4.28	($14,692)	$29,776	$13,207	>1	>1	$44,468	$27,899
CZ09-2	LA	-2,352	970	4.28	($14,692)	$25,823	$13,207	>1	>1	$40,516	$27,899
CZ10	SDG&E	-5,388	1262	4.95	($14,692)	$75,458	$11,493	>1	>1	$90,150	$26,185
CZ10-2	SCE	-5,388	1262	4.95	($14,692)	$32,394	$11,493	>1	>1	$47,086	$26,185
CZ11	PG&E	-14,533	2415	8.86	($14,692)	$7,618	$13,295	>1	>1	$22,310	$27,987
CZ12	PG&E	-14,764	2309	8.19	($14,692)	$2,210	$10,152	>1	>1	$16,902	$24,845
CZ12-2	SMUD	-14,764	2309	8.19	($14,692)	$21,215	$10,152	>1	>1	$35,907	$24,845
CZ13	PG&E	-12,069	1983	7.08	($14,692)	$5,647	$8,570	>1	>1	$20,339	$23,262
CZ14	SDG&E	-7,950	1672	6.45	($14,692)	$60,412	$16,679	>1	>1	$75,104	$31,371
CZ14-2	SCE	-7,950	1672	6.45	($14,692)	$28,631	$16,679	>1	>1	$43,323	$31,371
CZ15	SCE	2,534	518	3.10	($14,692)	$27,271	$17,162	>1	>1	$41,963	$31,855
CZ16	PG&E	-36,081	4304	14.26	($14,692)	($30,111)	($41,181)	0.5	0.4	($15,419)	($26,489)
CZ16-2	LA	-36,081	4304	14.26	($14,692)	$45,706	($41,181)	>1	0.4	$60,398	($26,489)

Figure 68. Cost Effectiveness for Medium Retail – All-Electric + 110kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 110kW PV											
CZ01	PG&E	115,344	3893	41.82	$143,932	$454,277	$296,025	3.2	2.1	$310,345	$152,093
CZ02	PG&E	150,004	2448	40.80	$139,516	$470,236	$371,817	3.4	2.7	$330,720	$232,301
CZ03	PG&E	158,951	1868	39.82	$142,869	$544,095	$370,696	3.8	2.6	$401,226	$227,827
CZ04	PG&E	163,043	1706	39.73	$144,084	$488,619	$388,847	3.4	2.7	$344,534	$244,763
CZ04-2	CPAU	163,043	1706	39.73	$144,084	$432,905	$388,847	3.0	2.7	$288,821	$244,763
CZ05	PG&E	165,711	1746	40.30	$141,473	$565,525	$382,760	4.0	2.7	$424,051	$241,287
CZ06	SCE	167,328	1002	37.24	$145,218	$306,670	$395,066	2.1	2.7	$161,452	$249,848
CZ06-2	LA	167,328	1002	37.24	$145,218	$184,797	$395,066	1.3	2.7	$39,579	$249,848
CZ07	SDG&E	178,042	522	37.07	$143,218	$428,332	$406,032	3.0	2.8	$285,114	$262,814
CZ08	SCE	171,149	793	36.94	$140,058	$301,219	$417,635	2.2	3.0	$161,161	$277,577
CZ08-2	LA	171,149	793	36.94	$140,058	$178,419	$417,635	1.3	3.0	$38,361	$277,577
CZ09	SCE	172,027	970	38.50	$134,867	$307,640	$414,075	2.3	3.1	$172,773	$279,208
CZ09-2	LA	172,027	970	38.50	$134,867	$187,813	$414,075	1.4	3.1	$52,946	$279,208
CZ10	SDG&E	171,107	1262	39.40	$139,708	$463,692	$403,505	3.3	2.9	$323,984	$263,796
CZ10-2	SCE	171,107	1262	39.40	$139,708	$311,464	$403,505	2.2	2.9	$171,755	$263,796
CZ11	PG&E	153,732	2415	41.41	$134,778	$467,356	$394,165	3.5	2.9	$332,578	$259,387
CZ12	PG&E	153,126	2309	40.61	$134,476	$467,106	$389,111	3.5	2.9	$332,630	$254,635
CZ12-2	SMUD	153,126	2309	40.61	$134,476	$283,343	$389,111	2.1	2.9	$148,867	$254,635
CZ13	PG&E	157,332	1983	39.97	$138,822	$477,831	$385,947	3.4	2.8	$339,008	$247,124
CZ14	SDG&E	179,582	1672	42.42	$140,324	$437,575	$452,729	3.1	3.2	$297,251	$312,405
CZ14-2	SCE	179,582	1672	42.42	$140,324	$309,064	$452,729	2.2	3.2	$168,740	$312,405
CZ15	SCE	180,751	518	37.26	$137,436	$294,877	$421,612	2.1	3.1	$157,440	$284,176
CZ16	PG&E	154,248	4304	51.20	$141,209	$473,892	$364,016	3.4	2.6	$332,682	$222,807
CZ16-2	LA	154,248	4304	51.20	$141,209	$211,677	$364,016	1.5	2.6	$70,467	$222,807

Figure 69. Cost Effectiveness for Medium Retail – All-Electric + 110kW PV + 50 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 90kW PV + 50 kWh Battery											
CZ01	PG&E	114,356	3893	43.52	$171,832	$451,043	$310,265	2.6	1.8	$279,211	$138,433
CZ02	PG&E	148,793	2448	42.89	$167,416	$475,081	$394,099	2.8	2.4	$307,664	$226,683
CZ03	PG&E	157,707	1868	42.12	$170,769	$541,418	$394,034	3.2	2.3	$370,649	$223,265
CZ04	PG&E	161,769	1706	41.82	$171,984	$523,603	$422,535	3.0	2.5	$351,618	$250,551
CZ04-2	CPAU	161,769	1706	41.82	$171,984	$430,567	$422,535	2.5	2.5	$258,582	$250,551
CZ05	PG&E	164,408	1746	42.68	$169,373	$561,966	$405,087	3.3	2.4	$392,592	$235,714
CZ06	SCE	166,052	1002	39.48	$173,118	$306,697	$414,756	1.8	2.4	$133,579	$241,638
CZ06-2	LA	166,052	1002	39.48	$173,118	$187,941	$414,756	1.1	2.4	$14,823	$241,638
CZ07	SDG&E	176,705	522	39.47	$171,118	$479,038	$428,490	2.8	2.5	$307,920	$257,372
CZ08	SCE	169,825	793	39.14	$167,958	$312,602	$436,709	1.9	2.6	$144,645	$268,751
CZ08-2	LA	169,825	793	39.14	$167,958	$187,142	$436,709	1.1	2.6	$19,185	$268,751
CZ09	SCE	170,747	970	40.23	$162,767	$318,113	$423,370	2.0	2.6	$155,346	$260,604
CZ09-2	LA	170,747	970	40.23	$162,767	$197,006	$423,370	1.2	2.6	$34,240	$260,604
CZ10	SDG&E	169,935	1262	41.08	$167,608	$503,504	$411,284	3.0	2.5	$335,896	$243,675
CZ10-2	SCE	169,935	1262	41.08	$167,608	$317,927	$411,284	1.9	2.5	$150,319	$243,675
CZ11	PG&E	152,559	2415	42.99	$162,678	$491,775	$420,667	3.0	2.6	$329,096	$257,989
CZ12	PG&E	151,956	2309	42.21	$162,376	$494,703	$417,063	3.0	2.6	$332,327	$254,687
CZ12-2	SMUD	151,956	2309	42.21	$162,376	$288,950	$417,063	1.8	2.6	$126,573	$254,687
CZ13	PG&E	156,271	1983	41.25	$166,722	$485,422	$395,770	2.9	2.4	$318,699	$229,047
CZ14	SDG&E	178,505	1672	43.94	$168,224	$452,456	$457,387	2.7	2.7	$284,232	$289,163
CZ14-2	SCE	178,505	1672	43.94	$168,224	$311,520	$457,387	1.9	2.7	$143,296	$289,163
CZ15	SCE	179,840	518	38.23	$165,336	$296,004	$422,293	1.8	2.6	$130,668	$256,957
CZ16	PG&E	152,965	4304	53.53	$169,109	$483,205	$378,299	2.9	2.2	$314,096	$209,190
CZ16-2	LA	152,965	4304	53.53	$169,109	$215,341	$378,299	1.3	2.2	$46,231	$209,190

6.7.3 Cost Effectiveness Results – Small Hotel

Figure 70 through Figure 77 contain the cost-effectiveness findings for the Small Hotel packages. Notable findings for each package include:

- **Mixed-Fuel + 3 kW PV:** Packages are cost effective and achieve savings for all climate zones for both the On-Bill and TDV approaches.
- **Mixed-Fuel + 3 kW PV + 5 kWh Battery:** The packages are less cost effective as compared to the previous minimal PV only package and not cost effective for LADWP and SMUD service area. The addition of battery reduces the cost effectiveness of packages.
- **Mixed-Fuel + PV only:** Packages are cost effective and achieve savings for the On-Bill approach for all climate zones except for LADWP territory. Packages are cost effective and achieve savings for the TDV approach for all climate zones.
- **Mixed-Fuel + PV + 50 kWh Battery:** Adding battery slightly reduces On-Bill B/C ratios. Packages are not cost effective for LADWP territory, SMUD territory as well as for climate zones 6,8,9 under PG&E service area.
- **All-Electric + 3 kW PV:** All packages are cost effective using the On-Bill approach. All packages are cost effective using the TDV approach but do not achieve positive energy cost savings.
- **All-Electric + 3 kW PV + 5 kWh Battery:** Similar to minimal PV only package, all packages are cost effective using the On-Bill approach. All packages are cost effective using the TDV approach but do not achieve positive energy cost savings.
- **All-Electric + PV only**: All packages are cost effective for both On-Bill and TDV approaches. Packages achieve on-bill savings for all climate zones.
- **All-Electric + PV + 50 kWh Battery:** Adding battery slightly reduces On-Bill B/C ratios but is still cost effective for all climate zones.

Figure 70. Cost Effectiveness for Small Hotel – Mixed Fuel + 3kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle $-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 3kW PV											
CZ01	PG&E	3,941	0	0.8	$5,566	$12,616	$8,326	2.3	1.5	$7,050	$2,760
CZ02	PG&E	4,785	0	0.9	$5,566	$12,639	$10,332	2.3	1.9	$7,073	$4,766
CZ03	PG&E	4,733	0	0.9	$5,566	$15,146	$9,991	2.7	1.8	$9,580	$4,425
CZ04	PG&E	4,834	0	1.0	$5,566	$13,266	$10,445	2.4	1.9	$7,700	$4,879
CZ04-2	CPAU	4,834	0	1.0	$5,566	$11,507	$10,445	2.1	1.9	$5,941	$4,879
CZ05	PG&E	5,027	0	1.0	$5,566	$16,048	$10,634	2.9	1.9	$10,482	$5,068
CZ06	SCE	4,769	0	0.9	$5,566	$10,276	$10,559	1.8	1.9	$4,710	$4,993
CZ06-2	LA	4,769	0	0.9	$5,566	$6,307	$10,559	1.1	1.9	$741	$4,993
CZ07	SDG&E	4,960	0	1.0	$5,566	$14,576	$10,861	2.6	2.0	$9,010	$5,295
CZ08	SCE	4,824	0	0.9	$5,566	$10,837	$11,202	1.9	2.0	$5,271	$5,636
CZ08-2	LA	4,824	0	0.9	$5,566	$6,505	$11,202	1.2	2.0	$939	$5,636
CZ09	SCE	4,779	0	0.9	$5,566	$10,298	$10,824	1.9	1.9	$4,732	$5,258
CZ09-2	LA	4,779	0	0.9	$5,566	$6,201	$10,824	1.1	1.9	$635	$5,258
CZ10	SDG&E	4,905	0	1.0	$5,566	$16,302	$10,710	2.9	1.9	$10,736	$5,144
CZ10-2	SCE	4,905	0	1.0	$5,566	$9,468	$10,710	1.7	1.9	$3,902	$5,144
CZ11	PG&E	4,701	0	0.9	$5,566	$14,193	$10,483	2.6	1.9	$8,627	$4,917
CZ12	PG&E	4,770	0	0.9	$5,566	$15,262	$10,596	2.7	1.9	$9,696	$5,030
CZ12-2	SMUD	4,770	0	0.9	$5,566	$7,848	$10,596	1.4	1.9	$2,282	$5,030
CZ13	PG&E	4,633	0	0.9	$5,566	$14,674	$10,105	2.6	1.8	$9,108	$4,539
CZ14	SDG&E	5,377	0	1.1	$5,566	$16,615	$12,375	3.0	2.2	$11,049	$6,809
CZ14-2	SCE	5,377	0	1.1	$5,566	$10,021	$12,375	1.8	2.2	$4,455	$6,809
CZ15	SCE	4,997	0	1.0	$5,566	$9,542	$11,164	1.7	2.0	$3,976	$5,598
CZ16	PG&E	5,240	0	1.0	$5,566	$14,961	$10,975	2.7	2.0	$9,395	$5,409
CZ16-2	LA	5,240	0	1.0	$5,566	$5,670	$10,975	1.0	2.0	$104	$5,409

Figure 71. Cost Effectiveness for Small Hotel – Mixed Fuel + 3kW PV + 5 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 3kW PV + 5kWh Battery											
CZ01	PG&E	3,941	0	0.8	$9,520	$12,616	$8,326	1.3	0.9	$3,096	($1,194)
CZ02	PG&E	4,785	0	0.9	$9,520	$12,639	$10,332	1.3	1.1	$3,119	$811
CZ03	PG&E	4,733	0	0.9	$9,520	$15,146	$9,991	1.6	1.0	$5,626	$471
CZ04	PG&E	4,834	0	1.0	$9,520	$13,266	$10,445	1.4	1.1	$3,746	$925
CZ04-2	CPAU	4,834	0	1.0	$9,520	$11,507	$10,445	1.2	1.1	$1,987	$925
CZ05	PG&E	5,027	0	1.0	$9,520	$16,048	$10,634	1.7	1.1	$6,528	$1,114
CZ05-2	SCG	5,027	0	1.0	$9,520	$16,048	$10,634	1.7	1.1	$6,528	$1,114
CZ06	SCE	4,769	0	0.9	$9,520	$10,276	$10,559	1.1	1.1	$756	$1,039
CZ06-2	LA	4,769	0	0.9	$9,520	$6,307	$10,559	0.7	1.1	($3,213)	$1,039
CZ07	SDG&E	4,960	0	1.0	$9,520	$14,576	$10,861	1.5	1.1	$5,056	$1,341
CZ08	SCE	4,824	0	0.9	$9,520	$10,837	$11,202	1.1	1.2	$1,317	$1,682
CZ08-2	LA	4,824	0	0.9	$9,520	$6,505	$11,202	0.7	1.2	($3,015)	$1,682
CZ09	SCE	4,779	0	0.9	$9,520	$10,298	$10,824	1.1	1.1	$778	$1,303
CZ09-2	LA	4,779	0	0.9	$9,520	$6,201	$10,824	0.7	1.1	($3,319)	$1,303
CZ10	SDG&E	4,905	0	1.0	$9,520	$16,302	$10,710	1.7	1.1	$6,782	$1,190
CZ10-2	SCE	4,905	0	1.0	$9,520	$9,468	$10,710	0.99	1.1	($52)	$1,190
CZ11	PG&E	4,701	0	0.9	$9,520	$14,193	$10,483	1.5	1.1	$4,673	$963
CZ12	PG&E	4,770	0	0.9	$9,520	$15,262	$10,596	1.6	1.1	$5,742	$1,076
CZ12-2	SMUD	4,770	0	0.9	$9,520	$7,848	$10,596	0.8	1.1	($1,672)	$1,076
CZ13	PG&E	4,633	0	0.9	$9,520	$14,674	$10,105	1.5	1.1	$5,154	$584
CZ14	SDG&E	5,377	0	1.1	$9,520	$16,615	$12,375	1.7	1.3	$7,095	$2,855
CZ14-2	SCE	5,377	0	1.1	$9,520	$10,021	$12,375	1.1	1.3	$501	$2,855
CZ15	SCE	4,997	0	1.0	$9,520	$9,542	$11,164	1.0	1.2	$22	$1,644
CZ16	PG&E	5,240	0	1.0	$9,520	$14,961	$10,975	1.6	1.2	$5,441	$1,455
CZ16-2	LA	5,240	0	1.0	$9,520	$5,670	$10,975	0.6	1.2	($3,851)	$1,455

Figure 72. Cost Effectiveness for Small Hotel - Mixed Fuel +80kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 80kW PV											
CZ01	PG&E	105,090	0	20.6	$179,470	$336,440	$221,883	1.9	1.2	$156,970	$42,413
CZ02	PG&E	127,592	0	25.0	$179,470	$320,009	$275,130	1.8	1.5	$140,539	$95,660
CZ03	PG&E	126,206	0	24.8	$179,470	$403,900	$266,426	2.3	1.5	$224,430	$86,956
CZ04	PG&E	128,894	0	25.4	$179,470	$322,782	$278,536	1.8	1.6	$143,312	$99,066
CZ04-2	CPAU	128,894	0	25.4	$179,470	$306,862	$278,536	1.7	1.6	$127,392	$99,066
CZ05	PG&E	134,041	0	26.5	$179,470	$427,935	$283,834	2.4	1.6	$248,465	$104,364
CZ06	SCE	127,168	0	25.0	$179,470	$200,425	$281,488	1.1	1.6	$20,955	$102,018
CZ06-2	LA	127,168	0	25.0	$179,470	$119,357	$281,488	0.7	1.6	($60,113)	$102,018
CZ07	SDG&E	132,258	0	26.1	$179,470	$247,646	$289,700	1.4	1.6	$68,176	$110,230
CZ08	SCE	128,641	0	25.3	$179,470	$207,993	$298,594	1.2	1.7	$28,523	$119,124
CZ08-2	LA	128,641	0	25.3	$179,470	$122,591	$298,594	0.7	1.7	($56,879)	$119,124
CZ09	SCE	127,447	0	25.3	$179,470	$211,567	$288,830	1.2	1.6	$32,096	$109,360
CZ09-2	LA	127,447	0	25.3	$179,470	$123,486	$288,830	0.7	1.6	($55,984)	$109,360
CZ10	SDG&E	130,792	0	25.8	$179,470	$274,832	$285,386	1.5	1.6	$95,361	$105,916
CZ10-2	SCE	130,792	0	25.8	$179,470	$206,865	$285,386	1.2	1.6	$27,395	$105,916
CZ11	PG&E	125,366	0	24.6	$179,470	$316,781	$279,331	1.8	1.6	$137,311	$99,861
CZ12	PG&E	127,203	0	25.0	$179,470	$406,977	$282,358	2.3	1.6	$227,507	$102,888
CZ12-2	SMUD	127,203	0	25.0	$179,470	$198,254	$282,358	1.1	1.6	$18,784	$102,888
CZ13	PG&E	123,535	0	24.4	$179,470	$317,261	$269,908	1.8	1.5	$137,791	$90,437
CZ14	SDG&E	143,387	0	28.1	$179,470	$309,521	$330,345	1.7	1.8	$130,051	$150,875
CZ14-2	SCE	143,387	0	28.1	$179,470	$225,083	$330,345	1.3	1.8	$45,612	$150,875
CZ15	SCE	133,246	0	25.9	$179,470	$207,277	$297,648	1.2	1.7	$27,807	$118,177
CZ16	PG&E	139,738	0	27.3	$179,470	$341,724	$292,728	1.9	1.6	$162,254	$113,258
CZ16-2	LA	139,738	0	27.3	$179,470	$114,215	$292,728	0.6	1.6	($65,255)	$113,258

Figure 73. Cost Effectiveness for Small Hotel – Mixed Fuel + 80kW PV + 50 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + 80kW PV + 50kWh Battery											
CZ01	PG&E	104,026	0	23.2	$207,370	$332,596	$237,740	1.6	1.1	$125,226	$30,370
CZ02	PG&E	126,332	0	28.1	$207,370	$336,179	$296,058	1.6	1.4	$128,809	$88,688
CZ03	PG&E	124,934	0	28.0	$207,370	$399,220	$289,360	1.9	1.4	$191,850	$81,990
CZ04	PG&E	127,602	0	28.5	$207,370	$332,161	$308,887	1.6	1.5	$124,790	$101,517
CZ04-2	CPAU	127,602	0	28.5	$207,370	$303,828	$308,887	1.5	1.5	$96,458	$101,517
CZ05	PG&E	132,725	0	29.8	$207,370	$423,129	$303,627	2.0	1.5	$215,758	$96,257
CZ06	SCE	125,880	0	28.4	$207,370	$193,814	$297,950	0.9	1.4	($13,556)	$90,580
CZ06-2	LA	125,880	0	28.4	$207,370	$123,083	$297,950	0.6	1.4	($84,287)	$90,580
CZ07	SDG&E	130,940	0	29.5	$207,370	$274,313	$309,682	1.3	1.5	$66,943	$102,312
CZ08	SCE	127,332	0	28.5	$207,370	$199,786	$312,899	1.0	1.5	($7,584)	$105,529
CZ08-2	LA	127,332	0	28.5	$207,370	$124,651	$312,899	0.6	1.5	($82,719)	$105,529
CZ09	SCE	126,232	0	28.2	$207,370	$206,706	$292,804	1.0	1.4	($664)	$85,433
CZ09-2	LA	126,232	0	28.2	$207,370	$126,710	$292,804	0.6	1.4	($80,660)	$85,433
CZ10	SDG&E	129,683	0	28.4	$207,370	$292,202	$287,278	1.4	1.4	$84,832	$79,908
CZ10-2	SCE	129,683	0	28.4	$207,370	$206,171	$287,278	1.0	1.4	($1,199)	$79,908
CZ11	PG&E	124,337	0	26.9	$207,370	$315,330	$283,683	1.5	1.4	$107,960	$76,313
CZ12	PG&E	126,013	0	27.8	$207,370	$403,127	$297,118	1.9	1.4	$195,757	$89,748
CZ12-2	SMUD	126,013	0	27.8	$207,370	$198,007	$297,118	1.0	1.4	($9,363)	$89,748
CZ13	PG&E	122,591	0	26.5	$207,370	$315,541	$280,996	1.5	1.4	$108,171	$73,626
CZ14	SDG&E	142,257	0	30.7	$207,370	$317,565	$334,697	1.5	1.6	$110,195	$127,327
CZ14-2	SCE	142,257	0	30.7	$207,370	$224,195	$334,697	1.1	1.6	$16,824	$127,327
CZ15	SCE	132,418	0	27.8	$207,370	$208,044	$299,199	1.0	1.4	$674	$91,829
CZ16	PG&E	138,402	0	30.7	$207,370	$358,582	$315,699	1.7	1.5	$151,212	$108,329
CZ16-2	LA	138,402	0	30.7	$207,370	$118,770	$315,699	0.6	1.5	($88,600)	$108,329

Figure 74. Cost Effectiveness for Small Hotel – All-Electric + 3kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost*	Lifecycle Energy Cost Savings	Lifecycle TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 3kW PV											
CZ01	PG&E	-155,861	16917	54.7	($1,265,139)	($568,892)	($106,835)	2.2	11.8	$696,246	$1,158,304
CZ02	PG&E	-113,954	12677	40.9	($1,266,111)	($229,433)	($41,288)	5.5	30.7	$1,036,679	$1,224,823
CZ03	PG&E	-105,862	12322	41.4	($1,268,383)	($309,874)	($41,175)	4.1	30.8	$958,510	$1,227,208
CZ04	PG&E	-108,570	11927	37.5	($1,268,218)	($208,239)	($42,689)	6.1	29.7	$1,059,980	$1,225,530
CZ04-2	CPAU	-108,570	11927	37.5	($1,268,218)	($6,261)	($42,689)	202.6	29.7	$1,261,958	$1,225,530
CZ05	PG&E	-103,579	11960	39.3	($1,268,272)	($332,879)	($44,051)	3.8	28.8	$935,393	$1,224,221
CZ06	SCE	-73,524	8912	30.3	($1,268,413)	$48,898	($17,484)	>1	72.5	$1,317,311	$1,250,929
CZ06-2	LA	-64,859	8188	29.0	($1,266,760)	($120,842)	($12,337)	10.5	102.7	$1,145,918	$1,254,423
CZ07	SDG&E	-67,090	8353	29.2	($1,264,731)	($43,964)	($11,618)	28.8	108.9	$1,220,767	$1,253,113
CZ08	SCE	-67,090	8353	29.2	($1,264,731)	$48,736	($11,618)	>1	108.9	$1,313,467	$1,253,113
CZ08-2	LA	-67,483	8402	29.3	($1,266,529)	($35,547)	($11,126)	35.6	113.8	$1,230,982	$1,255,403
CZ09	SCE	-67,483	8402	29.3	($1,266,529)	$52,410	($11,126)	>1	113.8	$1,318,939	$1,255,403
CZ09-2	LA	-75,157	8418	27.2	($1,263,531)	($156,973)	($25,469)	8.0	49.6	$1,106,558	$1,238,061
CZ10	SDG&E	-75,157	8418	27.2	($1,263,531)	($54,711)	($25,469)	23.1	49.6	$1,208,820	$1,238,061
CZ10-2	SCE	-94,783	10252	31.9	($1,264,340)	($169,847)	($38,904)	7.4	32.5	$1,094,493	$1,225,436
CZ11	PG&E	-94,702	10403	33.0	($1,265,779)	($324,908)	($34,968)	3.9	36.2	$940,872	$1,230,811
CZ12	PG&E	-94,297	10403	33.1	($1,265,779)	$13,603	($33,757)	>1	37.5	$1,279,382	$1,232,022
CZ12-2	SMUD	-92,196	10029	31.5	($1,264,152)	($168,358)	($40,229)	7.5	31.4	$1,095,794	$1,223,923
CZ13	PG&E	-96,021	10056	30.7	($1,264,510)	($308,542)	($44,202)	4.1	28.6	$955,969	$1,220,308
CZ14	SDG&E	-96,021	10056	30.7	($1,264,510)	($110,730)	($44,202)	11.4	28.6	$1,153,780	$1,220,308
CZ14-2	SCE	-44,856	5579	19.0	($1,262,631)	$8,996	($10,256)	>1	123.1	$1,271,627	$1,252,375
CZ15	SCE	-211,468	17599	42.9	($1,268,907)	($625,671)	($228,203)	2.0	5.6	$643,236	$1,040,704
CZ16	PG&E	-211,468	17599	42.9	($1,268,907)	$37,142	($228,203)	>1	5.6	$1,306,049	$1,040,704
CZ16-2	LA	-155,861	16917	54.7	($1,265,139)	($568,892)	($106,835)	2.2	11.8	$696,246	$1,158,304

Figure 75. Cost Effectiveness for Small Hotel – All-Electric + 3kW PV + 5 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 3kW PV + 5kWh Battery											
CZ01	PG&E	-155,861	16917	54.7	($1,288,428)	($568,892)	($106,835)	2.3	12.1	$719,536	$1,181,593
CZ02	PG&E	-113,954	12677	40.9	($1,288,428)	($229,433)	($41,288)	5.6	31.2	$1,058,996	$1,247,140
CZ03	PG&E	-105,862	12322	41.4	($1,288,428)	($309,874)	($41,175)	4.2	31.3	$978,554	$1,247,253
CZ04	PG&E	-108,570	11927	37.5	($1,288,428)	($208,239)	($42,689)	6.2	30.2	$1,080,190	$1,245,740
CZ04-2	CPAU	-108,570	11927	37.5	($1,288,428)	($6,261)	($42,689)	205.8	30.2	$1,282,167	$1,245,740
CZ05	PG&E	-103,579	11960	39.3	($1,288,428)	($332,879)	($44,051)	3.9	29.2	$955,549	$1,244,377
CZ06	SCE	-73,524	8912	30.3	($1,288,428)	($52,341)	($17,484)	24.6	73.7	$1,236,087	$1,270,944
CZ06-2	LA	-73,524	8912	30.3	($1,288,428)	$48,898	($17,484)	>1	73.7	$1,337,326	$1,270,944
CZ07	SDG&E	-64,859	8188	29.0	($1,288,428)	($120,842)	($12,337)	10.7	104.4	$1,167,586	$1,276,091
CZ08	SCE	-67,090	8353	29.2	($1,288,428)	($43,964)	($11,618)	29.3	110.9	$1,244,464	$1,276,810
CZ08-2	LA	-67,090	8353	29.2	($1,288,428)	$48,736	($11,618)	>1	110.9	$1,337,164	$1,276,810
CZ09	SCE	-67,483	8402	29.3	($1,288,428)	($35,547)	($11,126)	36.2	115.8	$1,252,881	$1,277,302
CZ09-2	LA	-67,483	8402	29.3	($1,288,428)	$52,410	($11,126)	>1	115.8	$1,340,838	$1,277,302
CZ10	SDG&E	-75,157	8418	27.2	($1,288,428)	($156,973)	($25,469)	8.2	50.6	$1,131,455	$1,262,959
CZ10-2	SCE	-75,157	8418	27.2	($1,288,428)	($54,711)	($25,469)	23.5	50.6	$1,233,718	$1,262,959
CZ11	PG&E	-94,783	10252	31.9	($1,288,428)	($169,847)	($38,904)	7.6	33.1	$1,118,582	$1,249,524
CZ12	PG&E	-94,702	10403	33.0	($1,288,428)	($324,908)	($34,968)	4.0	36.8	$963,520	$1,253,460
CZ12-2	SMUD	-94,297	10403	33.1	($1,288,428)	$13,603	($33,757)	>1	38.2	$1,302,031	$1,254,671
CZ13	PG&E	-92,196	10029	31.5	($1,288,428)	($168,358)	($40,229)	7.7	32.0	$1,120,071	$1,248,199
CZ14	SDG&E	-96,021	10056	30.7	($1,288,428)	($308,542)	($44,202)	4.2	29.1	$979,887	$1,244,226
CZ14-2	SCE	-96,021	10056	30.7	($1,288,428)	($110,730)	($44,202)	11.6	29.1	$1,177,698	$1,244,226
CZ15	SCE	-44,856	5579	19.0	($1,288,428)	$8,996	($10,256)	>1	125.6	$1,297,425	$1,278,172
CZ16	PG&E	-211,468	17599	42.9	($1,288,428)	($625,671)	($228,203)	2.1	5.6	$662,757	$1,060,225
CZ16-2	LA	-211,468	17599	42.9	($1,288,428)	$37,142	($228,203)	>1	5.6	$1,325,570	$1,060,225

Figure 76. Cost Effectiveness for Small Hotel – All-Electric + 80kW PV

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 80kW PV											
CZ01	PG&E	-54,712	16917	74.6	($1,123,442)	($240,170)	$106,722	4.7	>1	$883,272	$1,230,164
CZ02	PG&E	8,853	12677	65.0	($1,124,415)	$128,649	$223,510	>1	>1	$1,253,063	$1,347,925
CZ03	PG&E	15,612	12322	65.3	($1,126,687)	$44,532	$215,260	>1	>1	$1,171,219	$1,341,947
CZ04	PG&E	15,490	11927	62.0	($1,126,522)	$145,778	$225,402	>1	>1	$1,272,300	$1,351,924
CZ04-2	CPAU	15,490	11927	62.0	($1,126,522)	$289,094	$225,402	>1	>1	$1,415,616	$1,351,924
CZ05	PG&E	25,436	11960	64.8	($1,126,575)	$56,019	$229,149	>1	>1	$1,182,594	$1,355,724
CZ06	SCE	48,875	8912	54.4	($1,126,716)	$163,343	$253,445	>1	>1	$1,290,060	$1,380,161
CZ06-2	LA	62,439	8188	54.1	($1,125,064)	$115,822	$266,502	>1	>1	$1,240,886	$1,391,565
CZ07	SDG&E	56,727	8353	53.5	($1,123,034)	$147,987	$275,773	>1	>1	$1,271,022	$1,398,808
CZ08	SCE	56,727	8353	53.5	($1,123,034)	$163,971	$275,773	>1	>1	$1,287,005	$1,398,808
CZ08-2	LA	55,185	8402	53.7	($1,124,832)	$155,101	$266,880	>1	>1	$1,279,933	$1,391,712
CZ09	SCE	55,185	8402	53.7	($1,124,832)	$169,010	$266,880	>1	>1	$1,293,843	$1,391,712
CZ09-2	LA	50,731	8418	52.0	($1,121,834)	$113,936	$249,207	>1	>1	$1,235,770	$1,371,041
CZ10	SDG&E	50,731	8418	52.0	($1,121,834)	$138,265	$249,207	>1	>1	$1,260,099	$1,371,041
CZ10-2	SCE	25,882	10252	55.6	($1,122,643)	$162,626	$229,944	>1	>1	$1,285,269	$1,352,587
CZ11	PG&E	27,731	10403	57.1	($1,124,083)	$12,954	$236,794	>1	>1	$1,137,037	$1,360,876
CZ12	PG&E	28,136	10403	57.2	($1,124,083)	$206,756	$238,005	>1	>1	$1,330,839	$1,362,087
CZ12-2	SMUD	26,706	10029	55.0	($1,122,455)	$165,991	$219,574	>1	>1	$1,288,446	$1,342,030
CZ13	PG&E	41,989	10056	57.8	($1,122,814)	$22,333	$273,768	>1	>1	$1,145,147	$1,396,582
CZ14	SDG&E	41,989	10056	57.8	($1,122,814)	$120,943	$273,768	>1	>1	$1,243,757	$1,396,582
CZ14-2	SCE	83,393	5579	44.0	($1,120,934)	$210,511	$276,228	>1	>1	$1,331,445	$1,397,162
CZ15	SCE	-76,971	17599	69.2	($1,127,210)	($199,308)	$53,550	5.7	>1	$927,902	$1,180,760
CZ16	PG&E	-76,971	17599	69.2	($1,127,210)	$172,787	$53,550	>1	>1	$1,299,997	$1,180,760
CZ16-2	LA	-54,712	16917	74.6	($1,123,442)	($240,170)	$106,722	4.7	>1	$883,272	$1,230,164

Figure 77. Cost Effectiveness for Small Hotel – All-Electric + 80kW PV + 50 kWh Battery

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
All-Electric + 80kW PV + 50kWh Battery											
CZ01	PG&E	-55,323	16917	75.7	($1,095,542)	($238,351)	$118,605	4.6	>1	$857,191	$1,214,147
CZ02	PG&E	7,849	12677	67.4	($1,096,515)	$129,794	$239,632	>1	>1	$1,226,309	$1,336,146
CZ03	PG&E	14,594	12322	67.7	($1,098,787)	$43,166	$235,280	>1	>1	$1,141,953	$1,334,067
CZ04	PG&E	14,459	11927	64.4	($1,098,622)	$148,698	$249,244	>1	>1	$1,247,320	$1,347,866
CZ04-2	CPAU	14,459	11927	64.4	($1,098,622)	$286,573	$249,244	>1	>1	$1,385,195	$1,347,866
CZ05	PG&E	24,292	11960	67.6	($1,098,675)	$53,719	$244,514	>1	>1	$1,152,394	$1,343,189
CZ06	SCE	47,762	8912	57.2	($1,098,816)	$165,763	$267,221	>1	>1	$1,264,579	$1,366,037
CZ06-2	LA	61,252	8188	57.1	($1,097,164)	$138,060	$283,797	>1	>1	$1,235,223	$1,380,960
CZ07	SDG&E	55,588	8353	56.2	($1,095,134)	$138,718	$286,483	>1	>1	$1,233,852	$1,381,618
CZ08	SCE	55,588	8353	56.2	($1,095,134)	$165,932	$286,483	>1	>1	$1,261,066	$1,381,618
CZ08-2	LA	54,162	8402	56.1	($1,096,932)	$149,615	$269,453	>1	>1	$1,246,548	$1,366,386
CZ09	SCE	54,162	8402	56.1	($1,096,932)	$171,168	$269,453	>1	>1	$1,268,101	$1,366,386
CZ09-2	LA	49,832	8418	54.1	($1,093,934)	$120,627	$250,720	>1	>1	$1,214,561	$1,344,654
CZ10	SDG&E	49,832	8418	54.1	($1,093,934)	$136,144	$250,720	>1	>1	$1,230,078	$1,344,654
CZ10-2	SCE	25,148	10252	57.3	($1,094,743)	$160,744	$233,842	>1	>1	$1,255,487	$1,328,585
CZ11	PG&E	26,813	10403	59.2	($1,096,183)	$10,314	$247,504	>1	>1	$1,106,497	$1,343,686
CZ12	PG&E	27,217	10403	59.3	($1,096,183)	$206,749	$248,790	>1	>1	$1,302,931	$1,344,973
CZ12-2	SMUD	26,027	10029	56.5	($1,094,555)	$164,506	$229,300	>1	>1	$1,259,061	$1,323,856
CZ13	PG&E	41,123	10056	59.7	($1,094,914)	$25,707	$276,947	>1	>1	$1,120,621	$1,371,860
CZ14	SDG&E	41,123	10056	59.7	($1,094,914)	$119,382	$276,947	>1	>1	$1,214,296	$1,371,860
CZ14-2	SCE	82,697	5579	45.5	($1,093,034)	$209,837	$277,287	>1	>1	$1,302,871	$1,370,321
CZ15	SCE	-77,815	17599	71.1	($1,099,310)	($193,758)	$65,850	5.7	>1	$905,552	$1,165,160
CZ16	PG&E	-77,815	17599	71.1	($1,099,310)	$175,872	$65,850	>1	>1	$1,275,182	$1,165,160
CZ16-2	LA	-55,323	16917	75.7	($1,095,542)	($238,351)	$118,605	4.6	>1	$857,191	$1,214,147

6.8 List of Relevant Efficiency Measures Explored

The Reach Code Team started with a potential list of energy efficiency measures proposed for 2022 Title 24 codes and standards enhancement measures, as well as measures from the 2018 International Green Construction Code, which is based on ASHRAE Standard 189.1-2017. The team also developed new measures based on their experience. This original list was over 100 measures long. The measures were filtered based on applicability to the prototypes in this study, ability to model in simulation software, previously demonstrated energy savings potential, and market readiness. The list of 28 measures below represent the list of efficiency measures that meet these criteria and were investigated to some degree. The column to the far right indicates whether the measure was ultimately included in analysis or not.

Figure 78. List of Relevant Efficiency Measures Explored

Building Component	Measure Name	Measure Description	Notes	Include?
Water Heating	Drain water Heat Recovery	Add drain water heat recovery in hotel prototype	Requires calculations outside of modeling software.	Y
Envelope	High performance fenestration	Improved fenestration SHGC (reduce to 0.22).		Y
Envelope	High SHGC for cold climates	Raise prescriptive fenestration SHGC (to 0.45) in cold climates where additional heat is beneficial.		Y
Envelope	Allowable fenestration by orientation	Limit amount of fenestration as a function of orientation		Y
Envelope	High Thermal Mass Buildings	Increase building thermal mass. Thermal mass slows the change in internal temperature of buildings with respect to the outdoor temperature, allowing the peak cooling load during summer to be pushed to the evening, resulting in lower overall cooling loads.	Initial energy modeling results showed marginal cooling savings, negative heating savings.	N
Envelope	Opaque Insulation	Increases the insulation requirement for opaque envelopes (i.e., roof and above-grade wall).	Initial energy modeling results showed marginal energy savings at significant costs which would not meet c/e criteria.	N
Envelope	Triple pane windows	U-factor of 0.20 for all windows	Initial energy modeling results showed only marginal energy savings and, in some cases, increased energy use.	N

Building Component	Measure Name	Measure Description	Notes	Include?
Envelope	Duct Leakage Testing	Expand duct leakage testing requirements based on ASHRAE Standard 215-2018: Method of Test to Determine Leakage of Operating HVAC Air Distribution Systems (ANSI Approved).	More research needs to be done on current duct leakage and how it can be addressed.	N
Envelope	Fenestration area	Reduce maximum allowable fenestration area to 30%.	Instead of this measure, analyzed measure which looked at limiting fenestration based on wall orientation.	N
Envelope	Skinny triple pane windows	U-factor of 0.20 for all windows, with no changes to existing framing or building structure.	Market not ready. No commercially-available products for commercial buildings.	N
Envelope	Permanent projections	Detailed prescriptive requirements for shading based on ASHRAE 189. PF >0.50 for first story and >0.25 for other floors. Many exceptions. Corresponding SHGC multipliers to be used.	Title 24 already allows owner to trade off SHGC with permanent projections. Also, adding requirements for permanent projections would raise concerns.	N
Envelope	Reduced infiltration	Reduce infiltration rates by improving building sealing.	Infiltration rates are a fixed ACM input and cannot be changed. A workaround attempt would not be precise, and the practicality of implementation by developers is low given the modeling capabilities and the fact that in-field verification is challenging. Benefits would predominantly be for air quality rather than energy.	N

Building Component	Measure Name	Measure Description	Notes	Include?
HVAC	Heat recovery ventilation	For the hotel, recover and transfer heat from exhausted air to ventilation air.	For small hotels, the ventilation requirement could be met by various approaches, and the most common ones are: a. Exhaust only system, and ventilation is met by infiltration or window operation. b. Through a Z-duct that connects the zone AC unit's intake to an outside air intake louver. c. Centralized ventilation system (DOAS) The prototype developed for the small hotel is using Type 2 above. The major consideration is that currently, HRV + PTACs cannot be modeled at each guest room, only at the rooftop system. Option 1 would require the same type of HRV implementation as Option 2. Option 3 may be pursuable, but would require a significant redesign of the system, with questionable impacts. Previous studies have found heat recovery as cost effective in California only in buildings with high loads or high air exchange rates, given the relatively mild climate.	N
HVAC	Require Economizers in Smaller Capacity Systems	Lower the capacity trigger for air economizers. Previous studies have shown cost effectiveness for systems as low as 3 tons.		Y
HVAC	Reduce VAV minimum flow limit	Current T24 and 90.1 requirements limit VAV minimum flow rates to no more than 20% of maximum flow. Proposal based on ASHRAE Guideline 36 which includes sequences that remove technical barriers that previously existed. Also, most new DDC controllers are now capable of lower limits. The new limit may be as low as the required ventilation rate. A non-energy benefit of this measure is a reduction in over-cooling, thus improving comfort.		Y

Building Component	Measure Name	Measure Description	Notes	Include?
HVAC	Building Automation System (BAS) improvements	With adoption of ASHRAE Guideline 36 (GDL-36), there is now a national consensus standard for the description of high-performance sequences of operation. This measure will update BAS control requirements to improve usability and enforcement and to increase energy efficiency. BAS control requirement language will be improved either by adoption of similar language to GDL-36, or reference to GDL-36. Specific T24 BAS control topics that will be addressed include at a minimum: DCV, demand-based reset of SAT, demand-based reset of SP, dual-maximum zone sequences, and zone groups for scheduling.	In order to realize any savings in the difference, we would need a very detailed energy model with space-by-space load/occupant diversity, etc. We would also need more modeling capability than is currently available in CBECC-Com.	N
HVAC	Fault Detection Devices (FDD)	Expand FDD requirements to a wider range of AHU faults beyond the economizer. Fault requirements will be based on NIST field research, which has consequently been integrated into ASHRAE Guideline 36 Best in Class Sequences of Operations. Costs are solely to develop the sequences, which is likely minimal, and much of the hardware required for economizer FDD is also used to detect other faults.	Market not ready.	N
HVAC	Small circulator pumps ECM, trim to flow rate	Circulator pumps for industry and commercial.	Hot water pump energy use is small already (<1% building electricity usage) so not much savings potential. More savings for CHW pumps. Modeling limitations as well.	N
HVAC	High Performance Ducts to Reduce Static Pressure	Revise requirements for duct sizing to reduce static pressure.	Preliminary energy modeling results showed only marginal energy savings compared to measure cost.	N
HVAC	Parallel fan-powered boxes	Use of parallel fan-powered boxes	Unable to model PFPB with variable speed fans in modeling software.	N
Lighting	Daylight Dimming Plus OFF	Automatic daylight dimming controls requirements include the OFF step.		Y
Lighting	Occupant Sensing in Open Plan Offices	Take the PAF without allowing for increased design wattage		Y
Lighting	Institutional tuning	Take the PAF without allowing for increased design wattage		Y

Building Component	Measure Name	Measure Description	Notes	Include?
Lighting	Reduced Interior Lighting Power Density	Reduced interior LPD values.		Y
Lighting	Shift from general to task illumination	Low levels of general illumination with task and accent lighting added to locations where higher light levels are required. The shift from general to task illumination measure is based on the assumption that proper lighting of a desk surface with high efficacy lighting can allow for the significant reduction of ambient general lighting.	This is a tough measure to require as the LPDs decrease.	N
Lighting	Future-proof lighting controls	Fill any holes in the current code that could lead to the situations where TLEDS or LED fixtures that are not dimmable or upgradable in the future, or any other issues with code that make it hard to transition to ALCS/IoT lighting in the future	Major lighting controls already covered in other measures being considered	N
Lighting	Integrated control of lighting and HVAC systems	Formalize the definition of "lighting and HVAC control integration" by defining the level of data sharing required between systems and the mechanism needed to share such data. The highest savings potential would likely be generated from VAV HVAC systems by closing the damper in unoccupied zones based on the occupancy sensor information from the lighting systems.	Not market ready enough.	N
Other	NR Plug Load Controls	Energy savings opportunities for plug loads, which may include: energy efficient equipment, equipment power management, occupancy sensor control, and occupant awareness programs. The proposal could be extending controlled receptacles requirements in Section 130.5(d) to more occupancy types. It would also consider circuit-level controls.	Office equipment now all have their own standby power modes that use very little power, making plug load controls very difficult to be cost-effective.	N

6.9 Additional Rates Analysis - Healdsburg

After the final version of the report was released, the Reach Code Team provided additional cost effectiveness analysis in Climate Zone 2 using City of Healdsburg electric utility rates and PG&E gas rates. All aspects of the methodology remain the same, and the results for each package and prototype are aggregated below in Figure 79 through Figure 81. Results generally indicate:

- Mixed fuel prototypes achieve positive compliance margins for EE packages and are cost effective.
- All-electric prototypes achieve slightly lower compliance margins than mixed fuel for EE packages and are cost effective.
- All PV and PV+Battery packages are cost effective both using an on-bill and TDV approach.

Figure 79. Healdsburg Utility Rates Analysis – Medium Office, All Packages Cost Effectiveness Summary

Prototype	Package	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Comp-liance Margin (%)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Medium Office	Mixed Fuel + EE	40,985	-505	8.1	17%	$66,649	$89,645	$99,181	1.3	1.5	$22,996	$32,532
	Mixed Fuel + EE + PVB	255,787	-505	50.6	17%	$359,648	$510,922	$573,033	1.4	1.6	$151,274	$213,385
	Mixed Fuel + HE	3,795	550	4.3	4%	$68,937	$24,204	$24,676	0.4	0.4	-$44,733	-$44,261
	All-Electric	-49,684	3,868	5.0	-7%	-$73,695	-$7,042	-$41,429	10.5	1.8	$66,653	$32,266
	All-Electric + EE	-11,811	3,868	15.2	10%	-$7,046	$83,285	$58,563	>1	>1	$90,331	$65,609
	All-Electric + EE + PVB	203,026	3,868	57.8	10%	$285,953	$511,954	$532,273	1.8	1.9	$226,001	$246,320
	All-Electric + HE	-45,916	3,868	6.1	-5%	-$22,722	$6,983	-$26,394	>1	0.9	$29,705	-$3,672
	Mixed Fuel + 3kW	4,785	0	0.9	n/a	$5,566	$10,430	$10,500	1.9	1.9	$4,864	$4,934
	Mixed Fuel + 3kW + 5kWh	4,785	0	0.9	n/a	$8,356	$10,430	$10,500	1.2	1.3	$2,074	$2,144
	Mixed Fuel + 135kW	215,311	0	41.5	n/a	$250,470	$424,452	$471,705	1.7	1.9	$173,982	$221,235
	Mixed Fuel + 135kW + 50kWh	214,861	0	42.6	n/a	$278,370	$423,721	$472,898	1.5	1.7	$145,351	$194,528
	All-Electric + 3kW	-44,899	3,868	6.0	n/a	-$68,129	$3,299	-$30,928	>1	2.2	$71,429	$37,201
	All-Electric + 3kW + 5kWh	-44,899	3,868	6.0	n/a	-$65,339	$3,299	-$30,928	>1	2.1	$68,639	$34,411
	All-Electric + 135kW	165,627	3,868	46.6	n/a	$176,775	$424,146	$430,276	2.4	2.4	$247,371	$253,501
	All-Electric + 135kW + 50kWh	165,200	3,868	47.7	n/a	$204,675	$423,466	$431,469	2.1	2.1	$218,792	$226,795
	All-Electric + 80kW + 50kWh	40,985	-505	8.1	17%	$66,649	$89,645	$99,181	1.3	1.5	$22,996	$32,532

Figure 80. Healdsburg Utility Rates Analysis – Medium Retail, All Packages Cost Effectiveness Summary

Prototype	Package	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Comp-liance Margin (%)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Medium Retail	Mixed Fuel + EE	18,885	613	8.7	13%	$5,569	$49,546	$59,135	8.9	10.6	$43,977	$53,566
	Mixed Fuel + EE + PVB	189,400	613	43.8	13%	$249,475	$376,219	$465,474	1.5	1.9	$126,744	$215,999
	Mixed Fuel + HE	2,288	229	2.0	3%	$9,726	$13,143	$13,998	1.4	1.4	$3,417	$4,273
	All-Electric	-21,786	2,448	7.5	-1%	-$27,464	$9,228	-$4,483	>1	6.1	$36,692	$22,981
	All-Electric + EE	2,843	2,448	14.6	13%	-$21,895	$61,918	$56,893	>1	>1	$83,813	$78,788
	All-Electric + EE + PVB	173,387	2,448	49.9	13%	$222,012	$391,257	$463,431	1.8	2.1	$169,245	$241,419
	All-Electric + HE	-16,989	2,448	8.9	3%	-$4,211	$23,567	$11,251	>1	>1	$27,779	$15,463
	Mixed Fuel + 3kW	4,685	0	0.9	n/a	$5,566	$10,256	$10,262	1.8	1.8	$4,690	$4,696
	Mixed Fuel + 3kW + 5kWh	4,685	0	0.9	n/a	$8,356	$10,256	$10,262	1.2	1.2	$1,900	$1,906
	Mixed Fuel + 110kW	171,790	0	33.3	n/a	$204,087	$316,293	$376,300	1.5	1.8	$112,206	$172,213
	Mixed Fuel + 110kW + 50kWh	170,542	0	35.1	n/a	$231,987	$320,349	$398,363	1.4	1.7	$88,363	$166,376
	All-Electric + 3kW	-17,101	2,448	8.4	n/a	-$21,898	$19,523	$5,779	>1	>1	$41,421	$27,677
	All-Electric + 3kW + 5kWh	-17,101	2,448	8.4	n/a	-$19,108	$19,523	$5,779	>1	>1	$38,631	$24,887
	All-Electric + 110kW	150,004	2,448	40.8	n/a	$176,623	$332,213	$371,817	1.9	2.1	$155,591	$195,194
	All-Electric + 110kW + 50kWh	148,793	2,448	42.9	n/a	$204,523	$335,043	$394,099	1.6	1.9	$130,520	$189,577

Figure 81. Healdsburg Utility Rates Analysis – Small Hotel, All Packages Cost Effectiveness Summary

Prototype	Package	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Comp-liance Margin (%)	Incremental Package Cost	Lifecycle Energy Cost Savings	$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Small Hotel	Mixed Fuel + EE	3,802	976	3.9	7%	$20,971	$22,829	$29,353	1.1	1.4	$1,857	$8,381
	Mixed Fuel + EE + PVB	130,144	976	31.1	7%	$205,967	$254,577	$336,575	1.2	1.6	$48,610	$130,608
	Mixed Fuel + HE	981	402	2.7	3%	$23,092	$12,291	$11,808	0.5	0.5	-$10,801	-$11,284
	All-Electric	-118,739	12,677	40.0	-12%	-$1,297,757	-$24,318	-$51,620	53.4	25.1	$1,273,439	$1,246,137
	All-Electric + EE	-88,410	12,677	45.9	5%	-$1,265,064	$45,918	$20,860	>1	>1	$1,310,982	$1,285,924
	All-Electric + EE + PVB	38,115	12,677	73.5	5%	-$1,080,068	$296,233	$317,296	>1	>1	$1,376,301	$1,397,365
	All-Electric + HE	-118,284	12,677	41.2	-11%	-$1,283,243	-$83,994	-$44,505	15.3	28.8	$1,199,249	$1,238,738
	Mixed Fuel + 3kW	4,785	0	0.9	n/a	$5,566	$8,927	$10,332	1.6	1.9	$3,361	$4,766
	Mixed Fuel + 3kW + 5kWh	4,785	0	0.9	n/a	$8,356	$8,927	$10,332	1.1	1.2	$571	$1,976
	Mixed Fuel + 80kW	127,592	0	25.0	n/a	$148,427	$229,794	$275,130	1.5	1.9	$81,367	$126,703
	Mixed Fuel + 80kW + 50kWh	126,332	0	28.1	n/a	$176,327	$236,570	$296,058	1.3	1.7	$60,243	$119,731
	All-Electric + 3kW	-113,954	12,677	40.9	n/a	-$1,292,191	-$14,447	-$41,288	89.4	31.3	$1,277,744	$1,250,902
	All-Electric + 3kW + 5kWh	-113,954	12,677	40.9	n/a	-$1,289,401	-$14,447	-$41,288	89.3	31.2	$1,274,954	$1,248,112
	All-Electric + 80kW	8,853	12,677	65.0	n/a	-$1,149,330	$222,070	$223,510	>1	>1	$1,371,400	$1,372,840
	All-Electric + 80kW + 50kWh	7,849	12,677	67.4	n/a	-$1,121,430	$223,812	$239,632	>1	>1	$1,345,241	$1,361,062

ATTACHMENT 5

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Title 24, Parts 6 and 11
Local Energy Efficiency Ordinances

2019 Cost-effectiveness Study:
Low-Rise Residential New Construction

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Last Modified: August 01, 2019

LEGAL NOTICE

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Acronyms

2020 PV$	Present value costs in 2020
ACH50	Air Changes per Hour at 50 pascals pressure differential
ACM	Alternative Calculation Method
AFUE	Annual Fuel Utilization Efficiency
B/C	Lifecycle Benefit-to-Cost Ratio
BEopt	Building Energy Optimization Tool
BSC	Building Standards Commission
CAHP	California Advanced Homes Program
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
CMFNH	California Multifamily New Homes
CO_2	Carbon Dioxide
CPC	California Plumbing Code
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
NAECA	National Appliance Energy Conservation Act
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
PV	Photovoltaic
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SEER	Seasonal Energy Efficiency Ratio
SF	Single Family
CASE	Codes and Standards Enhancement
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

1 Introduction

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (Energy Commission, 2018b) 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.

This report documents cost-effective combinations of measures that exceed the minimum state requirements, the 2019 Building Energy Efficiency Standards, effective January 1, 2020, for new single family and low-rise (one- to three-story) multifamily residential construction. The analysis includes evaluation of both mixed fuel and all-electric homes, documenting that the performance requirements can be met by either type of building design. Compliance package options and cost-effectiveness analysis in all sixteen California climate zones (CZs) are presented (see Appendix A – California Climate Zone Map for a graphical depiction of Climate Zone locations). All proposed package options include a combination of efficiency measures and on-site renewable energy.

2 Methodology and Assumptions

This analysis uses two different metrics to assess cost-effectiveness. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with energy efficiency measures. 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 on-bill savings using electricity and natural gas utility rate schedules over a 30-year duration accounting for discount rate and energy cost inflation.
- **Time Dependent Valuation (TDV)**: Energy Commission LCC methodology, which is intended to capture the "societal value or cost" of energy use including 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 (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 (Horii et al., 2014). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in Title 24, Part 6.

2.1 Building Prototypes

The Energy Commission defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. At the time that this report was written, there are two single family prototypes and one low-rise multifamily prototype. All three are used in this analysis in development of the above-code packages. Table 1 describes the basic characteristics of each prototype. Additional details on the prototypes can be found in the Alternative Calculation Method (ACM) Approval Manual (Energy Commission, 2018a). The prototypes have equal geometry on all walls, windows and roof to be orientation neutral.

Table 1: Prototype Characteristics

Characteristic	Single Family One-Story	Single Family Two-Story	Multifamily
Conditioned Floor Area	2,100 ft^2	2,700 ft^2	6,960 ft^2: (4) 780 ft^2 & (4) 960 ft^2 units
Num. of Stories	1	2	2
Num. of Bedrooms	3	3	(4) 1-bed & (4) 2-bed units
Window-to-Floor Area Ratio	20%	20%	15%

Source: 2019 Alternative Calculation Method Approval Manual (California Energy Commission, 2018a).

The Energy Commission's protocol for 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, assuming 45 percent single-story and 55 percent two-story. Simulation results in this study are characterized according to this ratio, which is approximately equivalent to a 2,430-square foot (ft^2) house.[1]

The methodology used in the analyses for each of the prototypical building types begins with a design that precisely meets the minimum 2019 prescriptive requirements (zero compliance margin). Table 150.1-A in the 2019 Standards (Energy Commission, 2018b) 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 (Energy Commission, 2019), 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 2019 Standards.)
- Ductwork located in the attic for single family and within conditioned space for multifamily.

Both mixed fuel and all-electric prototypes are evaluated in this study. While in past code cycles an all-electric home was compared to a home with gas for certain end-uses, the 2019 code includes separate prescriptive and performance paths for mixed-fuel and all-electric homes. The fuel specific characteristics of the mixed fuel and all-electric prototypes are defined according to the 2019 ACM Reference Manual and described in Table 2.[2]

[1] 2,430 ft^2 = (45% x 2,100 ft^2) + (55% x 2,700 ft^2)

[2] Standards Section 150.1(c)8.A.iv.a specifies that compact hot water distribution design and a drain water heat recovery system or extra PV capacity are required when a heat pump water heater is installed prescriptively. The efficiency of the distribution and the drain water heat recovery systems as well as the location of the water heater applied in this analysis are based on the Standard Design assumptions in CBECC-Res which result in a zero-compliance margin for the 2019 basecase model.

Table 2: Characteristics of the Mixed Fuel vs All-Electric Prototype

Characteristic	Mixed Fuel	All-Electric
Space Heating/Cooling[1]	Gas furnace 80 AFUE Split A/C 14 SEER, 11.7 EER	Split heat pump 8.2 HSPF, 14 SEER, 11.7 EER
Water Heater[1,2, 3, 4]	Gas tankless UEF = 0.81	50gal HPWH UEF = 2.0 SF: located in the garage MF CZ 2,4,6-16: located in living space MF CZ 1,3,5: located in exterior closet
Hot Water Distribution	Code minimum. All hot water lines insulated	Basic compact distribution credit, (CZ 6-8,15) Expanded compact distribution credit, compactness factor = 0.6 (CZ 1-5,9-14,16)
Drain Water Heat Recovery Efficiency	None	CZ 1: unequal flow to shower = 42% CZ 16: equal flow to shower & water heater = 65% None in other CZs
Cooking	Gas	Electric
Clothes Drying	Gas	Electric

[1]Equipment efficiencies are equal to minimum federal appliance efficiency standards.
[2]The multifamily prototype is evaluated with individual water heaters. HPWHs located in the living space do not have ducting for either inlet or exhaust air; CBECC-Res does not have the capability to model ducted HPWHs.
[3]UEF = uniform energy factor. HPWH = heat pump water heater. SF = single family. MF = multifamily.
[4]CBECC-Res applies a 50gal water heater when specifying a storage water heater. Hot water draws differ between the prototypes based on number of bedrooms.

2.2 Measure Analysis

The California Building Energy Code Compliance simulation tool, CBECC-RES 2019.1.0, was used to evaluate energy impacts using the 2019 Title 24 prescriptive standards as the benchmark, and the 2019 TDV values. TDV is the energy metric used by the Energy Commission since the 2005 Title 24 energy code to evaluate compliance with the Title 24 standards.

Using the 2019 baseline as the starting point, prospective energy efficiency measures 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 exceed minimum code performance. The analysis utilizes a parametric tool based on Micropas[3] to automate and manage the generation of CBECC-Res input files. This allows for quick evaluation of various efficiency measures across multiple climate zones and prototypes and improves quality control. The batch process functionality of CBECC-Res is utilized to simulate large groups of input files at once. Annual utility costs were calculated using hourly data output from CBECC-Res and electricity and natural gas tariffs for each of the investor owned utilities (IOUs).

[3] Developed by Ken Nittler of Enercomp, Inc.

The Reach Codes Team selected packages and measures based on cost-effectiveness as well as decades of experience with residential architects, builders, and engineers along with general knowledge of the relative acceptance of many measures.

2.2.1 Federal Preemption

The Department of Energy (DOE) sets minimum efficiency standards for equipment and appliances that are federally regulated under the National Appliance Energy Conservation Act (NAECA), including heating, cooling, and water heating equipment. Since state and local governments are prohibited from adopting policies that mandate 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 equipment. While this study is limited by federal preemption, in practice builders may use any package of compliant measures to achieve the performance goals, including high efficiency appliances. Often, these measures are the simplest and most affordable measures to increase energy performance.

2.2.2 Energy Design Rating

The 2019 Title 24 code introduces California's Energy Design Rating (EDR) as the primary metric to demonstrate compliance with the energy code. EDR is still based on TDV but it uses 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 (Energy Commission, 2018d). See Figure 1 for a graphical representation of this. While the Reference Building is used to determine the rating, the Proposed Design is still compared to the Standard Design based on the prescriptive baseline assumptions to determine compliance.

The EDR is calculated by CBECC-Res and has two components:

1. An "Efficiency EDR" which represents the building's energy use without solar generation.[4]
2. A "Total EDR" that represents the final energy use of the building based on the combined impact of efficiency measures, PV generation and demand flexibility.

For a building to comply, two criteria are required:

(1) the proposed Efficiency EDR must be equal to or less than the Efficiency EDR of the Standard Design, and
(2) the proposed Total EDR must be equal to or less than the Total EDR of the Standard Design.

Single family prototypes used in this analysis that are minimally compliant with the 2019 Title 24 code achieve a Total EDR between 20 and 35 in most climates.

This concept, consistent with California's "loading order" which prioritizes energy efficiency ahead of renewable generation, requires projects meet a minimum Efficiency EDR before PV is credited but allows for PV to be traded off with additional efficiency when meeting the Total EDR. A project may improve on building efficiency beyond the minimum required and subsequently reduce the PV generation capacity required to achieve the required Total EDR but may not increase the size of the PV system and trade this off with a reduction of efficiency measures. Figure 1 graphically summarizes how both Efficiency EDR and PV / demand flexibility EDR are used to calculate the Total EDR used in the 2019 code and in this analysis.

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[4] While there is no compliance credit for solar PV as there is under the 2016 Standards, the credit for installing electric storage battery systems that meet minimum qualifications can be applied to the Efficiency EDR.

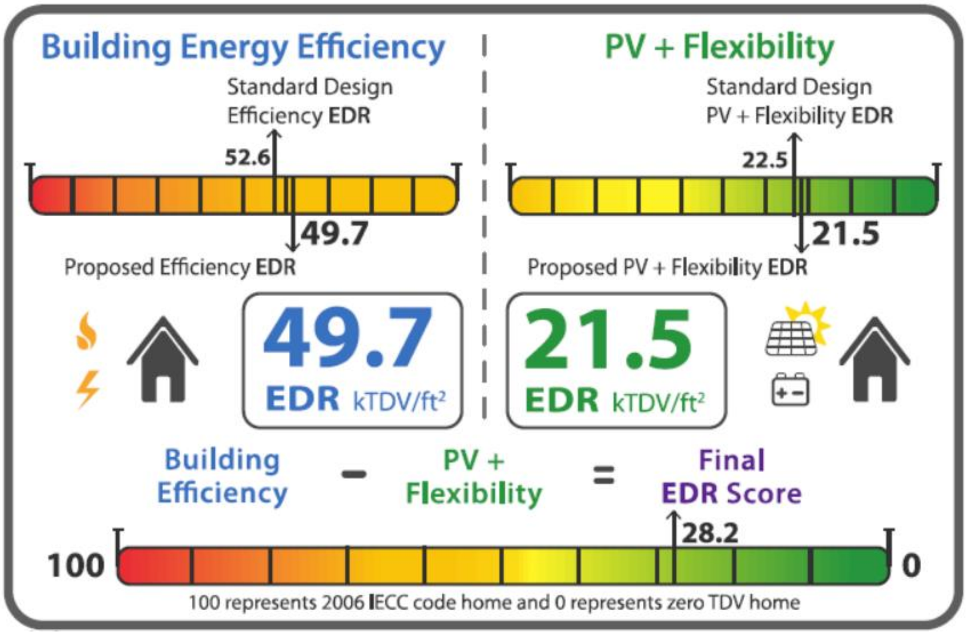

Figure 1: Graphical description of EDR scores (courtesy of Energy Code Ace[5])

Results from this analysis are presented as EDR Margin, a reduction in the EDR score relative to the Standard Design. EDR Margin is a better metric to use than absolute EDR in the context of a reach code because absolute values vary, based on the home design and characteristics such as size and orientation. This approach aligns with how compliance is determined for the 2019 Title 24 code, as well as utility incentive programs, such as the California Advanced Homes Program (CAHP) & California Multifamily New Homes (CMFNH), which require minimum performance criteria based on an EDR Margin for low-rise residential projects. The EDR Margin is calculated according to Equation 1 for the two efficiency packages and Equation 2 for the Efficiency & PV and Efficiency & PV/Battery packages (see Section 2.3).

Equation 1

$$EDR\ Margin_{\boldsymbol{efficiency}} = Standard\ Design\ \boldsymbol{Efficiency}\ EDR - Proposed\ Design\ \boldsymbol{Efficiency}\ EDR$$

Equation 2

$$EDR\ Margin_{\boldsymbol{efficiency}\ \&\ \boldsymbol{PV}} = Standard\ Design\ \boldsymbol{Total}\ EDR - Proposed\ Design\ \boldsymbol{Total}\ EDR$$

2.2.3 Energy Efficiency Measures

Following are descriptions of each of the efficiency measures evaluated under this analysis. Because not all of the measures described below were found to be cost-effective and cost-effectiveness varied by climate zone, not all measures are included in all packages and some of the measures listed are not included in any final package. For a list of measures included in each efficiency package by climate zone, see Appendix D – Single Family Measure Summary and Appendix F – Multifamily Measure Summary.

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 to 60 percent to either 3 ACH50 or 2 ACH50. HERS

[5] https://energycodeace.com/

[6] Whole house leakage tested at a pressure difference of 50 Pascals between indoors and outdoors.

rater field verification and diagnostic testing of building air leakage according to the procedures outlined in the 2019 Reference Appendices RA3.8 (Energy Commission, 2018c). This measure was not applied to multifamily homes because CBECC-Res does not allow reduced infiltration credit for multifamily buildings.

Improved Fenestration: Reduce window U-factor to 0.24. The prescriptive U-factor is 0.30 in all climates. In climate zones 1, 3, 5, and 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. Title 24 specifies a prescriptive ASR of 0.20 for Climate Zones 10 through 15 and assumes 0.10 in other climate zones.

Exterior Wall Insulation: Decrease wall U-factor in 2x6 walls to 0.043 from the prescriptive requirement of 0.048 by increasing exterior insulation from one-inch R-5 to 1-1/2 inch R-7.5. This was evaluated for single family buildings only in all climate zones except 6 and 7 where the prescriptive requirement is higher (U-factor of 0.065) and improving beyond the prescriptive value has little impact.

High Performance Attics (HPA): HPA with R-38 ceiling insulation and R-30 insulation under the roof deck. In climates where HPA is already required prescriptively this measure requires an incremental increase in roof insulation from R-19 or R-13 to R-30. In climates where HPA is not currently required (Climate Zones 1 through 3, and 5 through 7), this measure adds roof insulation to an uninsulated roof as well as increasing ceiling insulation from R-30 to R-38 in Climate Zones 3, 5, 6 and 7.

Slab Insulation: Install R-10 perimeter slab insulation at a depth of 16-inches. For climate zone 16, where slab insulation is required, prescriptively this measure increases that insulation from R-7 to R-10.

Duct Location (Ducts in Conditioned Space): Move the ductwork and equipment from the attic to inside the conditioned space in one of the three following ways.

1. Locate ductwork in conditioned space. The air handler may remain in the attic provided that 12 linear feet or less of duct is located outside the conditioned space including the air handler and plenum. Meet the requirements of 2019 Reference Appendices RA3.1.4.1.2. (Energy Commission, 2018c)
2. All ductwork and equipment located entirely in conditioned space meeting the requirements of 2019 Reference Appendices RA3.1.4.1.3. (Energy Commission, 2018c)
3. All ductwork and equipment located entirely in conditioned space with ducts tested to have less than or equal to 25 cfm leakage to outside. Meet the requirements of Verified Low Leakage Ducts in Conditioned Space (VLLDCS) in the 2019 Reference Appendices RA3.1.4.3.8. (Energy Commission, 2018c)

Option 1 and 2 above apply to single family only since the basecase for multifamily assumes ducts are within conditioned space. Option 3 applies to both single family and multifamily cases.

Reduced Distribution System (Duct) Leakage: Reduce duct leakage from 5% to 2% and install a low leakage air handler unit (LLAHU). This is only applicable to single family homes since the basecase for multifamily assumes ducts are within conditioned space and additional duct leakage credit is not available.

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 for gas furnaces and 0.45 Watts per cfm for heat pumps operating at full speed. 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 2019 Reference Appendices RA3.3 (Energy Commission, 2018c). New federal regulations that went into effect July 3, 2019 require higher fan efficiency for gas furnaces than for heat pumps and air handlers, which is why the recommended specification is different for mixed fuel and all-electric homes.

HERS Verification of Hot Water Pipe Insulation: The California Plumbing Code (CPC) requires pipe insulation on all hot water lines. This measure provides credit for HERS rater verification of pipe insulation requirements according to the procedures outlined in the 2019 Reference Appendices RA3.6.3. (Energy Commission, 2018c)

Compact Hot Water Distribution: Two credits for compact hot water distribution were evaluated.

1. Basic Credit: 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 2019 Reference Appendices RA4.4.6 (Energy Commission, 2018c). In many single family homes this may require moving the water heater from an exterior to an interior garage wall. Multifamily homes with individual water heaters are expected to easily meet this credit with little or no alteration to plumbing design. CBECC-Res software assumes a 30% reduction in distribution losses for the basic credit.
2. Expanded Credit: Design the hot water distribution system to meet minimum requirements for the expanded compact hot water distribution credit according to the procedures outlined in the 2019 Reference Appendices RA3.6.5 (Energy Commission, 2018c). In addition to requiring HERS verification that the minimum requirements for the basic compact distribution credit are met, this credit also imposes limitations on pipe location, maximum pipe diameter, and recirculation system controls allowed.

Drain Water Heat Recovery (DWHR): For multifamily buildings add DWHR that serves the showers in an unequal flow configuration (pre-heated water is piped directly to the shower) with 50% efficiency. This upgrade assumes all apartments are served by a DWHR with one unit serving each apartment individually. For a slab-on-grade building this requires a horizontal unit for the first-floor apartments.

Federally Preempted Measures:

The following additional measures were evaluated. Because these measures require upgrading appliances that are federally regulated to high efficiency models, they cannot be used to show cost-effectiveness in a local ordinance. The measures and packages are presented here to show that there are several options for builders to meet the performance targets. Heating and cooling capacities are autosized by CBECC-Res in all cases.

High Efficiency Furnace: For the mixed-fuel prototypes, upgrade natural gas furnace to one of two condensing furnace options with an efficiency of 92% or 96% AFUE.

High Efficiency Air Conditioner: For the mixed-fuel prototypes, upgrade the air conditioner to either single-stage SEER 16 / EER 13 or two-stage SEER 18 / EER 14 equipment.

High Efficiency Heat Pump: For the all-electric prototypes, upgrade the heat pump to either single-stage SEER 16 / EER 13 / HSPF 9 or two-stage SEER 18 / EER 14 / HSPF 10 equipment.

High Efficiency Tankless Water Heater: For the mixed-fuel prototype, upgrade tankless water heater to a condensing unit with a rated Uniform Energy Factor (UEF) of 0.96.

High Efficiency Heat Pump Water Heater (HPWH): For the all-electric prototypes, upgrade the federal minimum heat pump water heater to a HPWH that meets the Northwest Energy Efficiency Alliance (NEEA)[7] Tier 3 rating. The evaluated NEEA water heater is an 80gal unit and is applied to all three building prototypes. Using the same

[7] 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.

water heater provides consistency in performance across all the equipment upgrade cases, even though hot water draws differ across the prototypes.

2.3 Package Development

Three to four packages were evaluated for each prototype and climate zone, as described below.

1) **Efficiency – Non-Preempted**: This package uses only efficiency measures that don't trigger federal preemption issues including envelope, and water heating and duct distribution efficiency measures.
2) **Efficiency – Equipment, Preempted**: This package shows an alternative design that applies HVAC and water heating equipment that are more efficient than federal standards. The Reach Code Team considers this more reflective of how builders meet above code requirements in practice.
3) **Efficiency & PV**: Using the Efficiency – Non-Preempted Package as a starting point[8], PV capacity is added to offset most of the estimated electricity use. This only applies to the all-electric case, since for the mixed fuel cases, 100% of the projected electricity use is already being offset as required by 2019 Title 24, Part 6.
4) **Efficiency & PV/Battery**: Using the Efficiency & PV Package as a starting point, PV capacity is added as well as a battery system.

2.3.1 Solar Photovoltaics (PV)

Installation of on-site PV is required in the 2019 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.[9] In all cases, PV is evaluated in CBECC-Res according to the California Flexible Installation (CFI) assumptions.

The Reach Code Team used two options within the CBECC-Res software for sizing the PV system, described below. Analysis was conducted to determine the most appropriate sizing method for each package which is described in the results.

- Standard Design PV – the same PV capacity as is required for the Standard Design case[10]
- Specify PV System Scaling – a PV system sized to offset a specified percentage of the estimated electricity use of the Proposed Design case

2.3.2 Energy Storage (Batteries)

A battery system was evaluated in CBECC-Res with control type set to "Time of Use" and with default efficiencies of 95% for both charging and discharging. The "Time of Use" option assumes batteries are charged anytime PV generation is greater than the house load but controls when the battery storage system discharges. During the summer months (July – September) the battery begins to discharge at the beginning of the peak period at a maximum rate until fully discharged. During discharge the battery first serves the house load but will

[8] In cases where there was no cost-effective Efficiency – Non-Preempted Package, the most cost-effective efficiency measures for that climate zone were also included in the Efficiency & PV Package in order to provide a combination of both efficiency and PV beyond code minimum.

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

[10] 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.

discharge to the electric grid if there is excess energy available. During other months the battery discharges whenever the PV system does not cover the entire house load and does not discharge to the electric grid. This control option is considered to be most reflective of the current products on the market. This control option requires an input for the "First Hour of the Summer Peak" and the Statewide CASE Team applied the default hour in CBECC-Res which differs by climate zone (either a 6pm or 7pm start). The Self Utilization Credit was taken when the battery system was modeled.

2.4 Incremental Costs

Table 4 below summarizes the incremental cost assumptions for measures evaluated in this study. Incremental costs represent the equipment, installation, replacement, and maintenance costs of the proposed measures relative to the base case.[11] Replacement costs are applied to HVAC and DHW equipment, PV inverters, and battery systems over the 30-year evaluation period. There is no assumed maintenance on the envelope, HVAC, or DHW measures since there should not be any additional maintenance cost for a more efficient version of the same system type as the baseline. Costs were estimated to reflect costs to the building owner. When costs were obtained from a source that didn't already include builder overhead and profit, a markup of ten percent was added. All costs are provided as present value in 2020 (2020 PV$). Costs due to variations in furnace, air conditioner, and heat pump capacity by climate zone were not accounted for in the analysis.

Equipment lifetimes applied in this analysis for the water heating and space conditioning measures are summarized in Table 3.

Table 3: Lifetime of Water Heating & Space Conditioning Equipment Measures

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

Source: City of Palo Alto 2019 Title 24 Energy Reach Code Cost-effectiveness Analysis Draft (TRC, 2018) which is based on the Database of Energy Efficiency Resources (DEER).[12]

[11] Interest costs due to financing are not included in the incremental costs presented in the Table 4 but are accounted for in the lifetime cost analysis. All first costs are assumed to be financed in a mortgage, see Section 2.5 for details.

[12] http://www.deeresources.com

Table 4: Incremental Cost Assumptions

Measure	Performance Level	Incremental Cost (2020 PV$) Single Family	Incremental Cost (2020 PV$) Multifamily (Per Dwelling Unit)	Source & Notes
Non-Preempted Measures				
Reduced Infiltration	3.0 vs 5.0 ACH50	$391	n/a	NREL's BEopt cost database ($0.115/ft^2 for 3 ACH50 & $0.207/ft^2 for 2 ACH50) + $100 HERS rater verification.
	2.0 vs 5.0 ACH50	$613	n/a	
Window U-factor	0.24 vs 0.30	$2,261	$607	$4.23/ft^2 window area based on analysis conducted for the 2019 and 2022 Title 24 cycles (Statewide CASE Team, 2018).
Window SHGC	0.50 vs 0.35	$0	$0	Data from CASE Report along with direct feedback from Statewide CASE Team that higher SHGC does not necessarily have any incremental cost (Statewide CASE Team, 2017d). Applies to CZ 1,3,5,16.
Cool Roof - Aged Solar Reflectance	0.25 vs 0.20	$237	$58	Costs based on 2016 Cost-effectiveness Study for Cool Roofs reach code analysis for 0.28 solar reflectance product. (Statewide Reach Codes Team, 2017b).
	0.20 vs 0.10	$0	$0	
Exterior Wall Insulation	R-7.5 vs R-5	$818	n/a	Based on increasing exterior insulation from 1" R-5 to 1.5" R-7.5 in a 2x6 wall (Statewide CASE Team, 2017c). Applies to single family only in all climates except CZ 6, 7.
Under-Deck Roof Insulation (HPA)	R-13 vs R-0	$1,338	$334	Costs for R-13 ($0.64/ft^2), R-19 ($0.78/ft^2) and R-30 ($1.61/ft^2) based on data presented in the 2019 HPA CASE Report (Statewide CASE Team, 2017b) along with data collected directly from builders during the 2019 CASE process. The R-30 costs include additional labor costs for cabling. Costs for R-38 from NREL's BEopt cost database.
	R-19 vs R-13	$282	$70	
	R-30 vs R-19	$1,831	$457	
	R-38 vs R-30	$585	$146	
Attic Floor Insulation	R-38 vs R-30	$584	$146	NREL's BEopt cost database: $0.34/ft^2 ceiling area
Slab Edge Insulation	R-10 vs R-0	$553	$121	$4/linear foot of slab perimeter based on internet research. Assumes 16in depth.
	R-10 vs R-7	$157	$21	$1.58/linear foot of slab perimeter based on NREL's BEopt cost database. This applies to CZ 16 only where R-7 slab edge insulation is required prescriptively. Assumes 16in depth.
Duct Location	<12 feet in attic	$358	n/a	Costs based on a 2015 report on the Evaluation of Ducts in Conditioned Space for New California Homes (Davis Energy Group, 2015). HERS verification cost of $100 for the Verified Low Leakage Ducts in Conditioned Space credit.
	Ducts in Conditioned Space	$658	n/a	
	Verified Low Leakage Ducts in Conditioned Space	$768	$110	

Table 4: Incremental Cost Assumptions

Measure	Performance Level	Incremental Cost (2020 PV$) Single Family	Incremental Cost (2020 PV$) Multifamily (Per Dwelling Unit)	Source & Notes
Distribution System Leakage	2% vs 5%	$96	n/a	1-hour labor. Labor rate of $96 per hour is from 2019 RSMeans for sheet metal workers and includes an average City Cost Index for labor for California cities & 10% for overhead and profit. Applies to single family only since ducts are assumed to be in conditioned space for multifamily
	Low Leakage Air Handler	$0	n/a	Negligible cost based on review of available products. There are more than 6,000 Energy Commission certified units and the list includes many furnace and heat pump air handler product lines from the major manufacturers, including minimum efficiency, low cost product lines.
Low Pressure Drop Ducts (Fan W/cfm)	0.35 vs 0.45	$96	$48	Costs assume one-hour labor for single family and half-hour per multifamily apartment. Labor rate of $96 per hour is from 2019 RSMeans for sheet metal workers and includes an average City Cost Index for labor for California cities.
	0.45 vs 0.58	$96	$48	
Hot Water Pipe Insulation	HERS verified	$110	$83	Cost for HERS verification only, based on feedback from HERS raters. $100 per single family home and $75 per multifamily unit before markup.
Compact Hot Water Distribution	Basic credit	$150	$0	For single family add 20-feet venting at $12/ft to locate water heater on interior garage wall, less 20-feet savings for less PEX and pipe insulation at $4.88/ft. Costs from online retailers. Many multifamily buildings are expected to meet this credit without any changes to distribution design.
	Expanded credit	n/a	$83	Cost for HERS verification only. $75 per multifamily unit before markup. This was only evaluated for multifamily buildings.
Drain Water Heat Recovery	50% efficiency	n/a	$690	Cost from the 2019 DWHR CASE Report assuming a 2-inch DWHR unit. The CASE Report multifamily costs were based on one unit serving 4 dwelling units with a central water heater. Since individual water heaters serve each dwelling unit in this analysis, the Reach Code Team used single family costs from the CASE Report. Costs in the CASE Report were based on a 46.1% efficient unit, a DWHR device that meets the 50% efficiency assumed in this analysis may cost a little more. (Statewide CASE Team, 2017a).
Federally Pre-empted Measures				
Furnace AFUE	92% vs 80%	$139	$139	Equipment costs from online retailers for 40-kBtu/h unit. Cost saving for 6-feet of venting at $26/foot due to lower cost venting requirements for condensing (PVC) vs non-condensing (stainless) furnaces. Replacement at year 20 assumes a 50% reduction in first cost. Value at year 30 based on remaining useful life is included.
	96% vs 80%	$244	$244	
Air Conditioner SEER/EER	16/13 vs 14/11.7	$111	$111	Costs from online retailers for 2-ton unit. Replacement at year 20 assumes a 50% reduction in first cost. Value at year 30 based on remaining useful life is included.
	18/14 vs 14/11.7	$1,148	$1,148	

Table 4: Incremental Cost Assumptions

Measure	Performance Level	Incremental Cost (2020 PV$) Single Family	Incremental Cost (2020 PV$) Multifamily (Per Dwelling Unit)	Source & Notes
Heat Pump SEER/EER /HSPF	16/13/9 vs 14/11.7/8.2	$411	$411	Costs from online retailers for 2-ton unit. Replacement at year 15 assumes a 50% reduction in first cost.
	18/14/10 vs 14/11.7/8.2	$1,511	$1,511	
Tankless Water Heater Energy Factor	0.96 vs 0.81	$203	$203	Equipment costs from online retailers for 40-kBtu/h unit. Cost saving for 6-feet of venting at $26/foot due to lower cost venting requirements for condensing (PVC) vs non-condensing (stainless) furnaces. Replacement at year 15 assumes a 50% reduction in first cost.
HPWH	NEEA Tier 3 vs 2.0 EF	$294	$294	Equipment costs from online retailers. Replacement at year 15 assumes a 50% reduction in first cost.
PV + Battery				
PV System	System size varies	$3.72/W-DC	$3.17/W-DC	First costs are from LBNL's Tracking the Sun 2018 costs (Barbose et al., 2018) and represent costs for the first half of 2018 of $3.50/W-DC for residential system and $2.90/W-DC for non-residential system ≤500 kW-DC. These costs were reduced by 16% for the solar investment tax credit, which is the average credit over years 2020-2022. Inverter replacement cost of $0.14/W-DC present value includes replacements at year 11 at $0.15/W-DC (nominal) and at year 21 at $0.12/W-DC (nominal) per the 2019 PV CASE Report (California Energy Commission, 2017). System maintenance costs of $0.31/W-DC present value assume $0.02/W-DC (nominal) annually per the 2019 PV CASE Report (California Energy Commission, 2017). 10% overhead and profit added to all costs
Battery	System size varies by building type	$656/kWh	$656/kWh	$633/kWh first cost based on the PV Plus Battery Study report (Statewide Reach Codes Team, 2018) as the average cost of the three systems that were analyzed. This cost was reduced by 16% for the solar investment tax credit, which is the average credit over years 2020-2022. Replacement cost at year 15 of $100/kWh based on target price reductions (Penn, 2018).

2.5 Cost-effectiveness

Cost-effectiveness was evaluated for all sixteen climate zones and is presented based on both TDV energy, using the Energy Commission's LCC methodology, and an On-Bill approach using residential customer utility rates. Both methodologies require estimating and quantifying the value of the energy impact associated with energy efficiency measures over the life of the measures (30 years) as compared to the prescriptive Title 24 requirements.

Results are presented as a lifecycle benefit-to-cost (B/C) ratio, a net present value (NPV) metric which represents the cost-effectiveness of a measure over a 30-year lifetime taking into account discounting of future savings and costs and financing of incremental first costs. A value of one indicates the NPV of the savings over the life of the measure is equivalent to the NPV of the lifetime incremental cost of that measure. A value greater than one represents a positive return on investment. The B/C ratio is calculated according to Equation 3.

Equation 3

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

In most cases the benefit is represented by annual utility savings or TDV savings and the cost by incremental first cost and replacement costs. However, in some cases a measure may have incremental cost savings but with increased energy related costs. In this case, the benefit is the lower first cost and the cost is the increase in utility bills. The lifetime costs or benefits are calculated according to Equation 4.

Equation 4

$$\boldsymbol{NPV\ of\ lifetime\ cost/benefit = \sum_{t=1}^{n} Annual\ cost/benefit_t * (1+r)^t}$$

Where:

- n = analysis term
- r = discount rate

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

- Analysis term of 30-years
- Real discount rate of 3 percent
- Inflation rate of 2 percent
- First incremental costs are financed into a 30-year mortgage
- Mortgage interest rate of 4.5 percent
- Average tax rate of 20 percent (to account for tax savings due to loan interest deductions)

2.5.1 On-Bill Customer Lifecycle Cost

Residential utility rates were used to calculate utility costs for all cases and determine On-Bill customer cost-effectiveness for the proposed packages. The Reach Codes Team obtained the recommended utility rates from each IOU based on the assumption that the reach codes go into effect January of 2020. Annual utility costs were calculated using hourly electricity and gas output from CBECC-Res and applying the utility tariffs summarized in Table 5. Appendix B – Utility Tariff Details includes the utility rate schedules used for this study. The applicable residential time-of-use (TOU) rate was applied to all cases.[13] Annual electricity production in excess of annual electricity consumption is credited to the utility account at the applicable wholesale rate based on the approved

[13] Under NEM rulings by the CPUC (D-16-01-144, 1/28/16), all new PV customers shall be in an approved TOU rate structure. https://www.cpuc.ca.gov/General.aspx?id=3800

NEM2 tariffs for that utility. Minimum daily use billing and mandatory non-bypassable charges have been applied. Future change to the NEM tariffs are likely; however, there is a lot of uncertainty about what those changes will be and if they will become effective during the 2019 code cycle (2020-2022).
The net surplus compensation rates for each utility are as follows:[14]

- PG&E: $0.0287 / kWh
- SCE: $0.0301 / kWh
- SDG&E: $0.0355 / kWh

Utility rates were applied to each climate zone based on the predominant IOU serving the population of each zone according to Two SCE tariff options were evaluated: TOU-D-4-9 and TOU-D-PRIME. The TOU-D-PRIME rate is only available to customers with heat pumps for either space or water heating, a battery storage system, or an electric vehicle and therefore was only evaluated for the all-electric cases and the Efficiency & PV/Battery packages. The rate which resulted in the lowest annual cost to the customer was used for this analysis, which was TOU-D-4-9 in all cases with the exception of the single family all-electric cases in Climate Zone 14.

Table 5. Climate Zones 10 and 14 are 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 SCE tariff options were evaluated: TOU-D-4-9 and TOU-D-PRIME. The TOU-D-PRIME rate is only available to customers with heat pumps for either space or water heating, a battery storage system, or an electric vehicle and therefore was only evaluated for the all-electric cases and the Efficiency & PV/Battery packages. The rate which resulted in the lowest annual cost to the customer was used for this analysis, which was TOU-D-4-9 in all cases with the exception of the single family all-electric cases in Climate Zone 14.

Table 5: IOU Utility Tariffs Applied Based on Climate Zone

Climate Zones	Electric / Gas Utility	Electricity (Time-of-use)	Natural Gas
1-5, 11-13, 16	PG&E	E-TOU, Option B	G1
5	PG&E / SoCalGas	E-TOU, Option B	GR
6, 8-10, 14, 15	SCE / SoCal Gas	TOU-D-4-9 or TOU-D-PRIME	GR
7, 10, 14	SDG&E	TOU-DR1	GR

Source: Utility websites, See Appendix B – Utility Tariff Details for details on the tariffs applied.

Utility rates are assumed to escalate over time, using assumptions from research conducted by Energy and Environmental Economics (E3) in the 2019 study Residential Building Electrification in California study (Energy & Environmental Economics, 2019). Escalation of natural gas rates between 2019 and 2022 is based on the currently filed General Rate Cases (GRCs) for PG&E, SoCalGas and SDG&E. From 2023 through 2025, gas rates are assumed to escalate at 4% per year above inflation, which reflects historical rate increases between 2013 and 2018. Escalation of electricity rates from 2019 through 2025 is assumed to be 2% per year above inflation, based on electric utility estimates. After 2025, escalation rates for both natural gas and electric rates are assumed to drop to a more conservative 1% escalation per year above inflation for long-term rate trajectories beginning in 2026 through 2050. See Appendix B – Utility Tariff Details for additional details.

[14] Net surplus compensation rates based on 1-year average February 2018 – January 2019.

2.5.2 TDV Lifecycle Cost

Cost-effectiveness was also assessed using the Energy Commission's TDV LCC methodology. TDV is a normalized monetary format developed and used by the Energy Commission for comparing electricity and natural gas savings, and it considers the cost of electricity and natural gas consumed during different times of the day and year. The 2019 TDV values are based on long term discounted costs of 30 years for all residential measures. The CBECC-Res simulation software outputs are in terms of TDV kBTUs. The present value of the energy cost savings in dollars is calculated by multiplying the TDV kBTU savings by a net present value (NPV) factor, also developed by the Energy Commission. The NPV factor is $0.173/TDV kBtu for residential buildings.

Like the customer B/C ratio, a TDV B/C ratio 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. The ratio is calculated according to Equation 5.

Equation 5

$$TDV\ Benefit-to-Cost\ Ratio = \frac{TDV\ energy\ savings\ *\ NPV\ factor}{NPV\ of\ lifetime\ incremental\ cost}$$

2.6 Electrification Evaluation

In addition to evaluating upgrades to mixed fuel and all-electric buildings independently that do not result in fuel switching, the Reach Code Team also analyzed the impact on construction costs, utility costs, and TDV when a builder specifies and installs electric appliances instead of the gas appliances typically found in a mixed fuel building. This analysis compared the code compliant mixed fuel prototype, which uses gas for space heating, water heating, cooking, and clothes drying, with the code compliant all-electric prototype. It also compared the all-electric Efficiency & PV Package with the code compliance mixed fuel prototype. In these cases, the relative costs between natural gas and electric appliances, differences between in-house electricity and gas infrastructure and the associated infrastructure costs for providing gas to the building were also included.

A variety of sources were reviewed when determining incremental costs. The sources are listed below.

- SMUD All-Electric Homes Electrification Case Study (EPRI, 2016)
- City of Palo Alto 2019 Title 24 Energy Reach Code Cost-effectiveness Analysis (TRC, 2018)
- Building Electrification Market Assessment (E3, 2019)
- Decarbonization of Heating Energy Use in California Buildings (Hopkins et al., 2018)
- Analysis of the Role of Gas for a Low-Carbon California Future (Navigant, 2008)
- Rulemaking No. 15-03-010 An Order Instituting Rulemaking to Identify Disadvantaged Communities in the San Joaquin Valley and Analyze Economically Feasible Options to Increase Access to Affordable Energy in Those Disadvantages Communities (California Public Utilities Commission, 2016)
- 2010-2012 WO017 Ex Ante Measure Cost Study: Final Report (Itron, 2014)
- Natural gas infrastructure costs provided by utility staff through the Reach Code subprogram
- Costs obtained from builders, contractors and developers

Incremental costs are presented in Table 6. Values in parentheses represent a lower cost or cost reduction in the electric option relative to mixed fuel. The costs from the available sources varied widely, making it difficult to develop narrow cost estimates for each component. For certain components data is provided with a low to high range as well as what were determined to be typical costs and ultimately applied in this analysis. Two sets of typical costs are presented, one which is applied in the On-Bill cost effectiveness methodology and another applied in the TDV methodology. Details of these differences are explained in the discussion of site gas infrastructure costs in the following pages.

Table 6: Incremental Costs – All-Electric Code Compliant Home Compared to a Mixed Fuel Code Compliant Home

Measure	Incremental Cost (2020 PV$) Single Family[1]				Incremental Cost (2020 PV$) Multifamily[1] (Per Dwelling Unit)			
	Low	High	Typical (On-Bill)	Typical (TDV)	Low	High	Typical (On-Bill)	Typical (TDV)
Heat Pump vs Gas Furnace/Split AC	($2,770)	$620	($221)		Same as Single Family			
Heat Pump Water Heater vs Gas Tankless	($1,120)	$1,120	$0					
Electric vs Gas Clothes Dryer[2]	($428)	$820	$0					
Electric vs Gas Cooking[2]	$0	$1,800	$0					
Electric Service Upgrade	$200	$800	$600		$150	$600	$600	
In-House Gas Infrastructure	($1,670)	($550)	($800)		($600)	($150)	($600)	
Site Gas Infrastructure	($25,000)	($900)	($5,750)	($11,836)	($16,250)	($310)	($3,140)	($6,463)
Total First Cost	***($30,788)***	***$3,710***	***($6,171)***	***($12,257)***	***($20,918)***	***$4,500***	***($3,361)***	***($6,684)***
Present Value of Equipment Replacement Cost			***$1,266***				***$1,266***	
Lifetime Cost Including Replacement & Financing of First Cost			***($5,349)***	***($11,872)***			***($2,337)***	***($5,899)***

[1]Low and high costs represent the potential range of costs and typical represents the costs used in this analysis and determined to be most representative of the conditions described in this report. Two sets of typical costs are presented, one which is applied in the On-Bill cost effectiveness methodology and another applied in the TDV methodology.
[2]Typical costs assume electric resistance technology. The high range represents higher end induction cooktops and heat pump clothes dryers. Lower cost induction cooktops are available.

Typical incremental costs for switching from a mixed fuel design to an all-electric design are based on the following assumptions:

Appliances: The Reach Code Team determined that the typical first installed cost for electric appliances is very similar to that for natural gas appliances. This was based on information provided by HVAC contractors, plumbers and builders as well as a review of other studies. After review of various sources, the Reach Code Team concluded that the cost difference between gas and electric resistance options for clothes dryers and stoves is negligible and that the lifetimes of the two technologies are also similar.

HVAC: Typical HVAC incremental costs were based on the City of Palo Alto 2019 Title 24 Energy Reach Code Cost-effectiveness Analysis (TRC, 2018) which assumes approximately $200 first cost savings for the heat pump relative to the gas furnace and air conditioner. Table 6 also includes the present value of the incremental replacement costs for the heat pump based on a 15-year lifetime and a 20-year lifetime for the gas furnace in the mixed fuel home.

DHW: Typical costs for the water heating system were based on equivalent installed first costs for the HPWH and tankless gas water heater. This accounts for slightly higher equipment cost but lower installation labor due to the elimination of the gas flue. Incremental replacement costs for the HPWH are based on a 15-year lifetime and a 20-year lifetime for the tankless water heater.

For multifamily, less data was available and therefore a range of low and high costs is not provided. The typical first cost for multifamily similarly is expected to be close to the same for the mixed fuel and all-electric designs. However, there are additional considerations with multifamily such as greater complexity for venting of natural gas appliances as well as for locating the HPWH within the conditioned space (all climates except Climate Zones 1, 3, and 5, see Table 2) that may impact the total costs.

Electric service upgrade: The study assumes an incremental cost to run 220V service to each appliance of $200 per appliance for single family homes and $150 per appliance per multifamily apartment based on cost estimates from builders and contractors. The Reach Code Team reviewed production builder utility plans for mixed-fuel homes and consulted with contractors to estimate which electricity and/or natural gas services are usually provided to the dryer and oven. Typical practice varied, with some builders providing both gas and electric service to both appliances, others providing both services to only one of the appliances, and some only providing gas. For this study, the Reach Code Team determined that for single family homes the typical cost is best qualified by the practice of providing 220V service and gas to either the dryer and the oven and only gas service to the other. For multifamily buildings it's assumed that only gas is provided to the dryer and oven in the mixed fuel home.

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 new construction homes. There are no incremental electrical site infrastructure requirements.

In-house gas infrastructure (from meter to appliances): Installation cost to run a gas line from the meter to the appliance location is $200 per appliance for single family and $150 per appliance per multifamily apartment based on cost estimates from builders and contractors. The cost estimate includes providing gas to the water heater, furnace, dryer and cooktop.

Site gas infrastructure: The cost-effective analysis components with the highest degree of variability are the costs for on-site gas infrastructure. These costs can be project dependent and may be significantly impacted by such factors as utility territory, site characteristics, distance to the nearest 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 typical infrastructure costs for single family homes presented in Table 6 are based on cost data provided by PG&E and reflect those for a new subdivision in an undeveloped area requiring the installation of natural gas infrastructure, including a main line. Infrastructure costs for infill development can also be highly variable and may be higher than in an undeveloped area. The additional costs associated with disruption of existing roads, sidewalks, and other structures can be significant. Total typical costs in Table 6 assume $10,000 for extension of a gas main, $1,686 for a service lateral, and $150 for the meter.

Utility Gas Main Extensions rules[15] specify that the developer has the option to only pay 50% of the total cost for a main extension after subtraction of allowances for installation of gas appliances. This 50% refund and the appliance allowance deductions are accounted for in the site gas infrastructure costs under the On-Bill cost-effectiveness methodology. The net costs to the utility after partial reimbursement from the developer are included in utility ratebase and recovered via rates to all customers. The total cost of $5,750 presented in Table 6 reflects a 50% refund on the $10,000 extension and appliance deductions of $1,086 for a furnace, water heater, cooktop, and dryer. Under the On-Bill methodology this analysis assumes this developer option will remain available through 2022 and that the cost savings are passed along to the customer.

The 50% refund and appliance deductions were not applied to the site gas infrastructure costs under the TDV cost-effectiveness methodology based on input received from the Energy Commission and agreement from the Reach Code 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.

[15] PG&E Rule 15: https://www.pge.com/tariffs/tm2/pdf/GAS_RULES_15.pdf

SoCalGas Rule 20: https://www.socalgas.com/regulatory/tariffs/tm2/pdf/20.pdf

SDG&E Rule 15: http://regarchive.sdge.com/tm2/pdf/GAS_GAS-RULES_GRULE15.pdf

Less information was available for the costs associated with gas infrastructure for low-rise multifamily development. The typical cost in Table 6 for the On-Bill methodology is based on TRC's City of Palo Alto 2019 Title 24 Energy Reach Code Cost-effectiveness Analysis (TRC, 2018). These costs, provided by the City of Palo Alto, are approximately $25,100 for an 8-unit new construction building and reflect connection to an existing main for infill development. Specific costs include plan review, connection charges, meter and manifold, plumbing distribution, and street cut fees. While these costs are specifically based on infill development and from one municipal utility, the estimates are less than those provided by PG&E reflecting the average cost differences charged to the developer between single family and multifamily in an undeveloped area (after accounting for deductions per the Gas Main Extensions rule). To convert costs charged to the developer to account for the full infrastructure upgrade cost (costs applied in the TDV methodology analysis), a factor of 2.06[16] was calculated based on the single family analysis. This same factor was applied to the multifamily cost of $3,140 to arrive at $6,463 (see Table 6).

2.7 Greenhouse Gas Emissions

Equivalent CO_2 emission savings were calculated based on outputs from the CBECC-Res simulation software. Electricity emissions vary by region and by hour of the year. CBECC-Res applies two distinct hourly profiles, one for Climate Zones 1 through 5 and 11 through 13 and another for Climate Zones 6 through 10 and 14 through 16. For natural gas a fixed factor of 0.005307 metric tons/therm is used. To compare the mixed fuel and all-electric cases side-by-side, greenhouse gas (GHG) emissions are presented as CO_2-equivalent emissions per square foot of conditioned floor area.

3 Results

The primary objective of the evaluation is to identify cost-effective, non-preempted performance targets for both single family and low-rise multifamily prototypes, under both mixed fuel and all-electric cases, to support the design of local ordinances requiring new low-rise residential buildings to exceed the minimum state requirements. The packages presented are representative examples of designs and measures that can be used to meet the requirements. In practice, a builder can use any combination of non-preempted or preempted compliant measures to meet the requirements.

This analysis covered all sixteen climate zones and evaluated two efficiency packages, including a non-preempted package and a preempted package that includes upgrades to federally regulated equipment, an Efficiency & PV Package for the all-electric scenario only, and an Efficiency & PV/Battery Package. For the efficiency-only packages, measures were refined to ensure that the non-preempted package was cost-effective based on one of the two metrics applied in this study, TDV or On-Bill. The preempted equipment package, which the Reach Code Team considers to be a package of upgrades most reflective of what builders commonly apply to exceed code requirements, was designed to be cost-effective based on the On-Bill cost-effectiveness approach.

Results are presented as EDR Margin instead of compliance margin. EDR is the metric used to determine code compliance in the 2019 cycle. Target EDR Margin is based on taking the calculated EDR Margin for the case and rounding down to the next half of a whole number. Target EDR Margin for the Efficiency Package are defined based on the lower of the EDR Margin of the non-preempted package and the equipment, preempted package. For example, if for a particular case the cost-effective non-preempted package has an EDR Margin of 3 and the preempted package an EDR Margin of 4, the Target EDR Margin is set at 3.

[16] This factor includes the elimination of the 50% refund for the main extension and adding back in the appliance allowance deductions.

For a package to qualify, a minimum EDR Margin of 0.5 was required. This is to say that a package that only achieved an EDR Margin of 0.4, for example, was not considered. An EDR Margin less than 0.5 generally corresponds to a compliance margin lower than 5% and was considered too small to ensure repeatable results. In certain cases, the Reach Code Team did not identify a cost-effective package that achieved the minimum EDR Margin of 0.5.

Although some of the efficiency measures evaluated were not cost-effective and were eliminated, the following measures are included in at least one package:

- Reduced infiltration
- Improved fenestration
- Improved cool roofs
- High performance attics
- Slab insulation
- Reduced duct leakage
- Verified low leakage ducts in conditioned space
- Low pressure-drop distribution system
- Compact hot water distribution system, basic and expanded
- High efficiency furnace, air conditioner & heat pump (*preempted*)
- High efficiency tankless water heater & heat pump water heater (*preempted*)

3.1 PV and Battery System Sizing

The approach to determining the size of the PV and battery systems varied based on each package and the source fuel. Table 7 describes the PV and battery sizing approaches applied to each of the four packages. For the **Efficiency Non-preempted and Efficiency – Equipment, Preempted packages** a different method was applied to each the two fuel scenarios. In all **mixed fuel cases**, the PV was sized to offset 100% of the estimated electrical load and any electricity savings from efficiency measures were traded off with a smaller PV system. Not downsizing the PV system after adding efficiency measures runs the risk of producing more electricity than is consumed, reducing cost-effectiveness and violating NEM rules. While the impact of this in most cases is minor, analysis confirmed that cost-effectiveness improved when reducing the system size to offset 100% of the electricity usage as opposed to keeping the PV system the same size as the Standard Design.

In the **all-electric Efficiency cases**, the PV system size was left to match the Standard Design (Std Design PV), and the inclusion of energy efficiency measures was not traded off with a reduced capacity PV system. Because the PV system is sized to meet the electricity load of a mixed fuel home, it is cost-effective to keep the PV system the same size and offset a greater percentage of the electrical load.

For the **Efficiency & PV case on the all-electric home**, the Reach Code Team evaluated PV system sizing to offset 100%, 90% and 80% of the total calculated electricity use. Of these three, sizing to 90% proved to be the most cost-effective based on customer utility bills. This is a result of the impact of the annual minimum bill which is around $120 across all the utilities. The “sweet spot” is a PV system that reduces electricity bills just enough to match the annual minimum bill; increasing the PV size beyond this adds first cost but does not result in utility bill savings.

Table 7: PV & Battery Sizing Details by Package Type

Package	Mixed Fuel	All-Electric
Efficiency (Envelope & Equipment)	PV Scaled @ 100% electricity	Std Design PV
Efficiency & PV	n/a	PV Scaled @ 90%
Efficiency & PV/Battery	PV Scaled @ 100% electricity 5kWh / SF home 2.75kWh/ MF apt	PV Scaled @ 100% 5kWh / SF home 2.75kWh/ MF apt

A sensitivity analysis was conducted to determine the appropriate battery and PV capacity for the Efficiency & PV/Battery Packages using the 1-story 2,100 square foot prototype in Climate Zone 12. Results are shown in Figure 2. The current version of CBECC-Res requires a minimum battery size of 5 kWh to qualify for the self-utilization credit. CBECC-Res allows for PV oversizing up to 160% of the building's estimated electricity load when battery storage systems are installed; however, the Reach Code Team considered this high, potentially problematic from a grid perspective, and likely not acceptable to the utilities or customers. The Reach Code Team compared cost-effectiveness of 5kWh and 7.5kWh battery systems as well as of PV systems sized to offset 90%, 100%, or 120% of the estimated electrical load.

Results show that from an on-bill perspective a smaller battery size is more cost-effective. The sensitivity analysis also showed that increasing the PV capacity from 90% to 120% of the electricity use reduced cost-effectiveness. From the TDV perspective there was little difference in results across all the scenarios, with the larger battery size being marginally more cost-effective. Based on these results, the Reach Code Team applied to the Efficiency & PV/Battery Package a 5kWh battery system for single family homes with PV sized to offset 100% of the electricity load. Even though PV scaled to 90% was the most cost-effective, sizing was increased to 100% to evaluate greater generation beyond the Efficiency & PV Package and to achieve zero net electricity. These results also show that in isolation, the inclusion of a battery system reduces cost-effectiveness compared to the same size PV system without batteries.

For multifamily buildings the battery capacity was scaled to reflect the average ratio of battery size to PV system capacity (kWh/kW) for the single family Efficiency & PV Package. This resulted in a 22kWh battery for the multifamily building, or 2.75kWh per apartment.

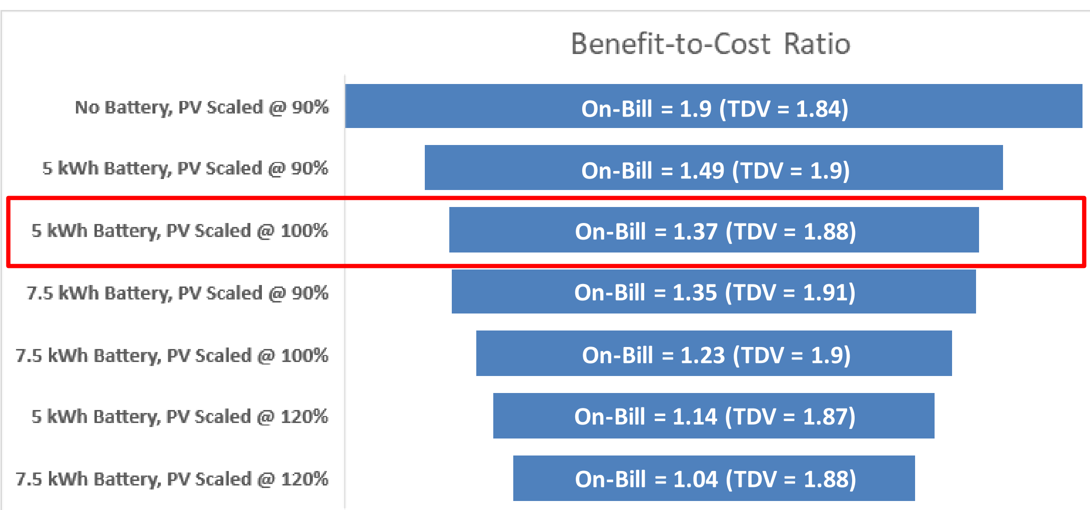

Figure 2: B/C ratio comparison for PV and battery sizing

3.2 Single Family Results

Table 8 through Table 10 contain cost effectiveness findings for the single family packages. Table 8 summarizes the package costs for all of the mixed fuel and all-electric efficiency, PV and battery packages. The mixed fuel results are evaluated and presented relative to a mixed fuel code compliant basecase while the all-electric results are relative to an all-electric code compliant basecase.

Table 9 and Table 10 present the B/C ratios for all the single family packages according to both the On-Bill and TDV methodologies for the mixed fuel and the all-electric cases, respectively. Results are cost-effective based on TDV for all cases except for Climate Zone 7 where no cost-effective combination of non-preempted efficiency measures was found that met the minimum 0.5 EDR Margin threshold. Cases where the B/C ratio is indicated as ">1" refer to instances where there are incremental cost savings in addition to annual utility bill savings. In these cases, there is no cost associated with the upgrade and benefits are realized immediately.

Figure 3 presents a comparison of Total EDRs for single family buildings and Figure 4 presents the EDR Margin results. Each graph compares the mixed fuel and all-electric cases as well as the various packages. The EDR Margin for the **Efficiency Package** for most climates is between 1.0 and 5.5 for mixed fuel cases and slightly higher, between 1.5 and 6.5, for the all-electric design. No cost-effective **mixed fuel or all-electric non-preempted Efficiency package** was found Climate Zone 7.

For the **mixed fuel case, the Efficiency & PV/Battery** Package increased the EDR Margin to values between 7.0 and 10.5. Because of the limitations on oversizing PV systems to offset natural gas use it is not feasible to achieve higher EDR Margins by increasing PV system capacity.

For the **all-electric case, the Efficiency & PV** Package resulted in EDR Margins of 11.0 to 19.0 for most climates; adding a battery system increased the EDR Margin by an additional 7 to 13 points. Climate zones 1 and 16, which have high heating loads, have much higher EDR Margins for the Efficiency & PV package (26.5-31.0). The Standard Design PV, which is what is applied in the all-electric Efficiency Package, is not sized to offset any of the heating load. When the PV system is sized to offset 90% of the total electricity use, the increase is substantial as a result. In contrast, in Climate Zone 15 the Standard Design PV system is already sized to cover the cooling electricity load, which represents 40% of whole building electricity use. Therefore, increasing the PV size to offset 90% of the electric load in this climate only results in adding approximately 120 Watts of PV capacity and subsequently a negligible impact on the EDR.

Additional results details can be found in Appendix C – Single Family Detailed Results with summaries of measures included in each of the packages in Appendix D – Single Family Measure Summary. A summary of results by climate zone is presented in Appendix G – Results by Climate Zone.

Table 8: Single Family Package Lifetime Incremental Costs

Climate Zone	Mixed Fuel			All-Electric			
	Non-Preempted	Equipment - Preempted	Efficiency & PV/Battery	Non-Preempted	Equipment - Preempted	Efficiency & PV	Efficiency & PV/Battery
CZ01	+$1,355	+$1,280	+$5,311	+$7,642	+$2,108	+$18,192	+$24,770
CZ02	+$1,504	+$724	+$5,393	+$3,943	+$2,108	+$12,106	+$18,132
CZ03	+$1,552	+$1,448	+$5,438	+$1,519	+$2,108	+$8,517	+$14,380
CZ04	+$1,556	+$758	+$5,434	+$1,519	+$2,108	+$8,786	+$14,664
CZ05	+$1,571	+$772	+$5,433	+$1,519	+$2,108	+$8,307	+$14,047
CZ06	+$1,003	+$581	+$4,889	+$926	+$846	+$6,341	+$12,036
CZ07	n/a	+$606	+$4,028	n/a	+$846	+$4,436	+$9,936
CZ08	+$581	+$586	+$4,466	+$926	+$412	+$5,373	+$11,016
CZ09	+$912	+$574	+$4,785	+$1,180	+$846	+$5,778	+$11,454
CZ10	+$1,648	+$593	+$5,522	+$1,773	+$949	+$6,405	+$12,129
CZ11	+$3,143	+$1,222	+$7,026	+$3,735	+$2,108	+$10,827	+$17,077
CZ12	+$1,679	+$654	+$5,568	+$3,735	+$2,108	+$11,520	+$17,586
CZ13	+$3,060	+$611	+$6,954	+$4,154	+$2,108	+$10,532	+$16,806
CZ14	+$1,662	+$799	+$5,526	+$4,154	+$2,108	+$10,459	+$16,394
CZ15	+$2,179	-($936)	+$6,043	+$4,612	+$2,108	+$5,085	+$11,382
CZ16	+$3,542	+$2,441	+$7,399	+$5,731	+$2,108	+$16,582	+$22,838

Table 9: Single Family Package Cost-Effectiveness Results for the Mixed Fuel Case [1,2]

		Efficiency							Efficiency & PV/Battery			
		Non-Preempted			Equipment - Preempted			Target				Target
CZ	Utility	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR Margin
01	PG&E	5.3	3.4	2.8	6.9	4.9	4.1	5.0	10.6	0.9	1.6	10.5
02	PG&E	3.3	1.6	1.7	3.3	3.8	3.6	3.0	10.1	0.5	1.6	10.0
03	PG&E	3.0	1.3	1.3	4.1	1.9	2.0	2.5	10.0	0.4	1.4	10.0
04	PG&E	2.5	0.9	1.2	2.7	2.4	2.7	2.5	10.1	0.3	1.5	10.0
05	PG&E	2.7	1.1	1.2	2.6	2.3	2.5	2.5	9.4	0.4	1.3	9.0
05	PG&E/SoCalGas	2.7	0.9	1.2	2.6	2.0	2.5	2.5	9.4	0.3	1.3	9.0
06	SCE/SoCalGas	2.0	0.7	1.2	2.0	1.6	2.0	1.5	9.8	0.8	1.3	9.5
07	SDG&E	0.0	-	-	1.5	1.5	1.4	0.0	9.2	0.1	1.3	9.0
08	SCE/SoCalGas	1.3	0.6	1.4	1.6	1.3	1.8	1.0	8.4	0.9	1.3	8.0
09	SCE/SoCalGas	2.6	0.7	2.0	2.9	1.8	3.7	2.5	8.8	1.0	1.5	8.5
10	SCE/SoCalGas	3.2	0.6	1.3	3.2	2.0	3.8	3.0	9.6	1.0	1.5	9.5
10	SDG&E	3.2	0.8	1.3	3.2	2.6	3.8	3.0	9.6	0.6	1.5	9.5
11	PG&E	4.3	0.8	1.2	5.1	2.5	3.7	4.0	9.2	0.4	1.5	9.0
12	PG&E	3.5	1.2	1.8	3.4	3.3	4.6	3.0	9.6	0.4	1.7	9.5
13	PG&E	4.6	0.8	1.3	5.8	5.3	8.4	4.5	9.7	0.4	1.6	9.5
14	SCE/SoCalGas	5.0	1.6	2.5	5.8	4.0	6.1	4.5	9.0	1.3	1.7	9.0
14	SDG&E	5.0	1.9	2.5	5.8	4.9	6.1	4.5	9.0	1.2	1.7	9.0
15	SCE/SoCalGas	4.8	1.0	1.6	5.0	>1	>1	4.5	7.1	1.1	1.5	7.0
16	PG&E	5.4	1.6	1.5	6.2	2.2	2.2	5.0	10.5	0.9	1.4	10.5

[1] ">1" indicates cases where there are both first cost savings and annual utility bill savings.
[2] Information about the measures included for each climate zone are described in Appendix D – Single Family Measure Summary.

Table 10: Single Family Package Cost-Effectiveness Results for the All-Electric Case[1,2]

		Efficiency							Efficiency & PV				Efficiency & PV/Battery			
		Non-Preempted			Equipment - Preempted			Target				Target				Target
CZ	Utility	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR Margin	Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR Margin
01	PG&E	15.2	1.8	1.7	6.9	2.9	2.7	6.5	31.4	1.8	1.5	31.0	41.2	1.4	1.4	41.0
02	PG&E	4.9	1.2	1.1	5.1	2.3	2.1	4.5	19.4	1.8	1.4	19.0	30.1	1.4	1.4	30.0
03	PG&E	4.7	2.6	2.4	4.4	1.8	1.6	4.0	18.5	2.2	1.7	18.0	29.3	1.5	1.6	29.0
04	PG&E	3.4	1.9	1.8	3.9	1.5	1.5	3.0	17.2	2.1	1.6	17.0	28.6	1.5	1.6	28.5
05	PG&E	4.4	2.6	2.3	4.4	1.9	1.7	4.0	18.2	2.3	1.8	18.0	28.7	1.6	1.6	28.5
05	PG&E/SoCalGas	4.4	2.6	2.3	4.4	1.9	1.7	4.0	18.2	2.3	1.8	18.0	28.7	1.6	1.6	28.5
06	SCE/SoCalGas	2.0	1.3	1.4	2.9	2.2	2.3	2.0	14.3	1.2	1.5	14.0	26.1	1.2	1.4	26.0
07	SDG&E	0.0	-	-	2.2	1.6	1.7	0.0	11.3	1.9	1.5	11.0	24.2	1.3	1.5	24.0
08	SCE/SoCalGas	1.6	0.6	1.2	1.8	2.8	3.0	1.5	10.9	1.0	1.5	10.5	21.6	1.1	1.4	21.5
09	SCE/SoCalGas	2.8	0.8	2.0	3.3	2.1	3.2	2.5	11.5	1.1	1.6	11.5	21.3	1.1	1.5	21.0
10	SCE/SoCalGas	3.1	0.9	1.5	3.4	2.3	3.2	3.0	11.1	1.1	1.5	11.0	21.2	1.1	1.5	21.0
10	SDG&E	3.1	1.1	1.5	3.4	2.6	3.2	3.0	11.1	1.7	1.5	11.0	21.2	1.4	1.5	21.0
11	PG&E	4.6	1.2	1.5	5.9	3.0	3.3	4.5	14.2	1.8	1.6	14.0	23.2	1.5	1.6	23.0
12	PG&E	3.8	0.8	1.1	5.1	2.0	2.5	3.5	15.7	1.7	1.4	15.5	25.4	1.3	1.5	25.0
13	PG&E	5.1	1.1	1.4	6.0	2.9	3.3	5.0	13.4	1.7	1.5	13.0	22.5	1.4	1.5	22.0
14	SCE/SoCalGas	5.6	1.0	1.5	6.0	2.3	3.1	5.5	15.5	1.2	1.6	15.5	23.9	1.4	1.6	23.5
14	SDG&E	5.6	1.3	1.5	6.0	2.9	3.1	5.5	15.5	1.8	1.6	15.5	23.9	1.7	1.6	23.5
15	SCE/SoCalGas	5.6	1.1	1.6	7.3	3.3	4.5	5.5	6.2	1.1	1.6	6.0	13.5	1.2	1.5	13.0
16	PG&E	9.7	1.7	1.7	4.9	2.4	2.3	4.5	27.0	2.1	1.6	26.5	35.4	1.7	1.5	35.0

[1]“>1” indicates cases where there are both first cost savings and annual utility bill savings.

[2]Information about the measures included for each climate zone are described in Appendix D – Single Family Measure Summary

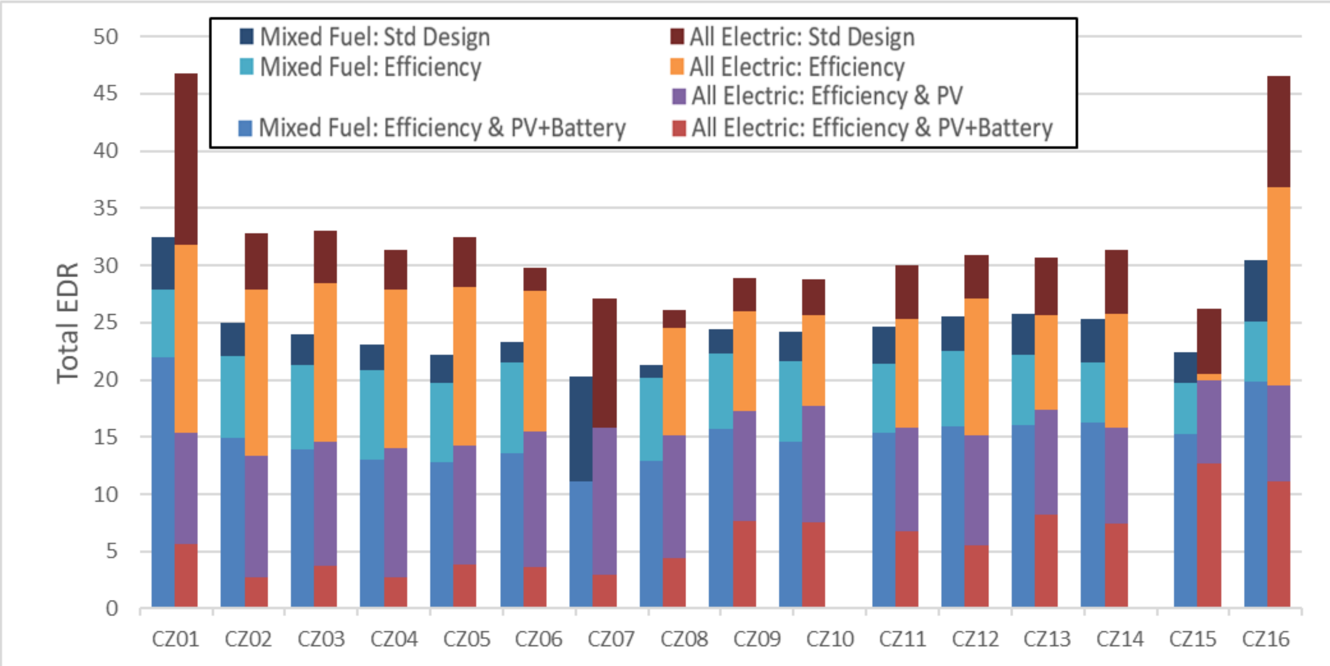

Figure 3: Single family Total EDR comparison

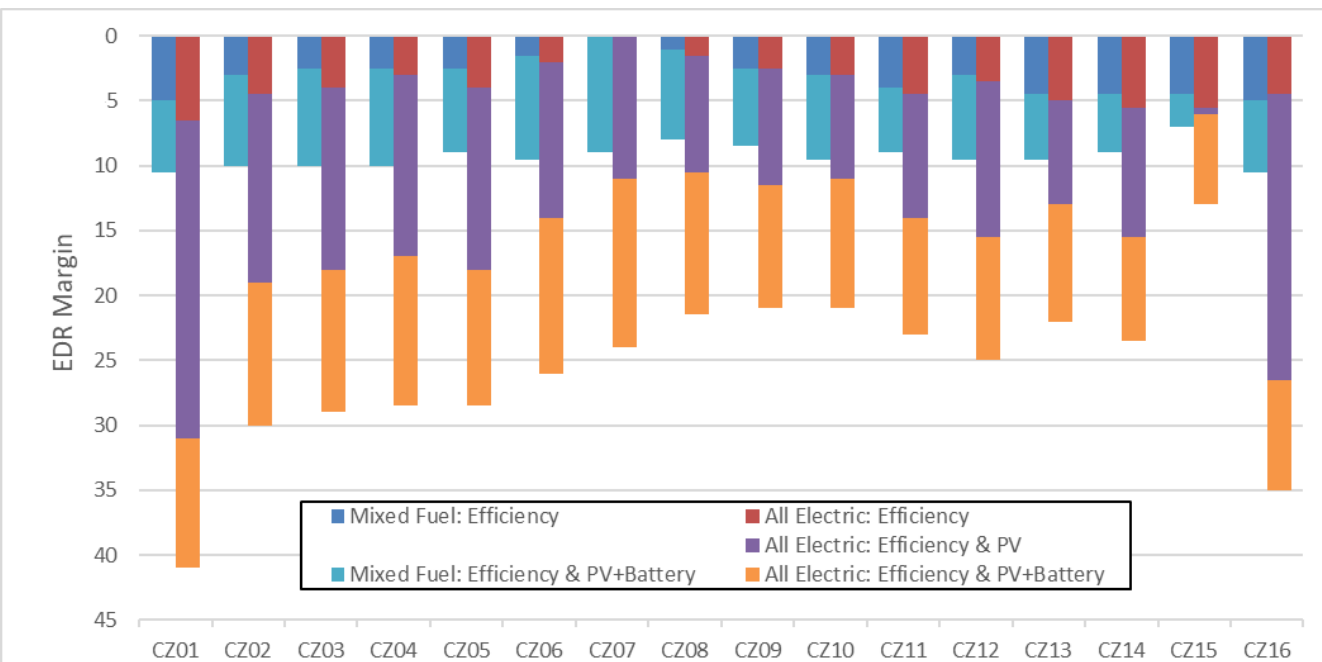

Figure 4: Single family EDR Margin comparison (based on Efficiency EDR Margin for the Efficiency packages and the Total EDR Margin for the Efficiency & PV and Efficiency & PV/Battery packages)

3.2.1 GHG Emission Reductions

Figure 5 compares annual GHG emissions for both mixed fuel and all-electric single family 2019 code compliant cases with Efficiency, Efficiency & PV and Efficiency & PV/Battery packages. GHG emissions vary by climate but are consistently higher in mixed fuel cases than all-electric. Standard Design mixed fuel emissions range from 1.3 (CZ 7) to 3.3 (CZ 16) lbs CO2e/square foot of floor area, where all-electric Standard Design emissions range from 0.7 to 1.7 lbs CO2e/ ft^2. Adding efficiency, PV and batteries to the mixed fuel code compliant prototype reduces GHG emissions by 20% on average to between 1.0 and 1.8 lbs CO2e/ ft^2, with the exception of Climate Zones 1 and 16. Adding efficiency, PV and batteries to the all-electric code compliant prototype reduces annual GHG emissions by 65% on average to 0.8 lbs CO2e/ ft^2 or less. None of the cases completely eliminate GHG emissions. Because of the time value of emissions calculation for electricity in CBECC-Res, there is always some amount of GHG impacts with using electricity from the grid.

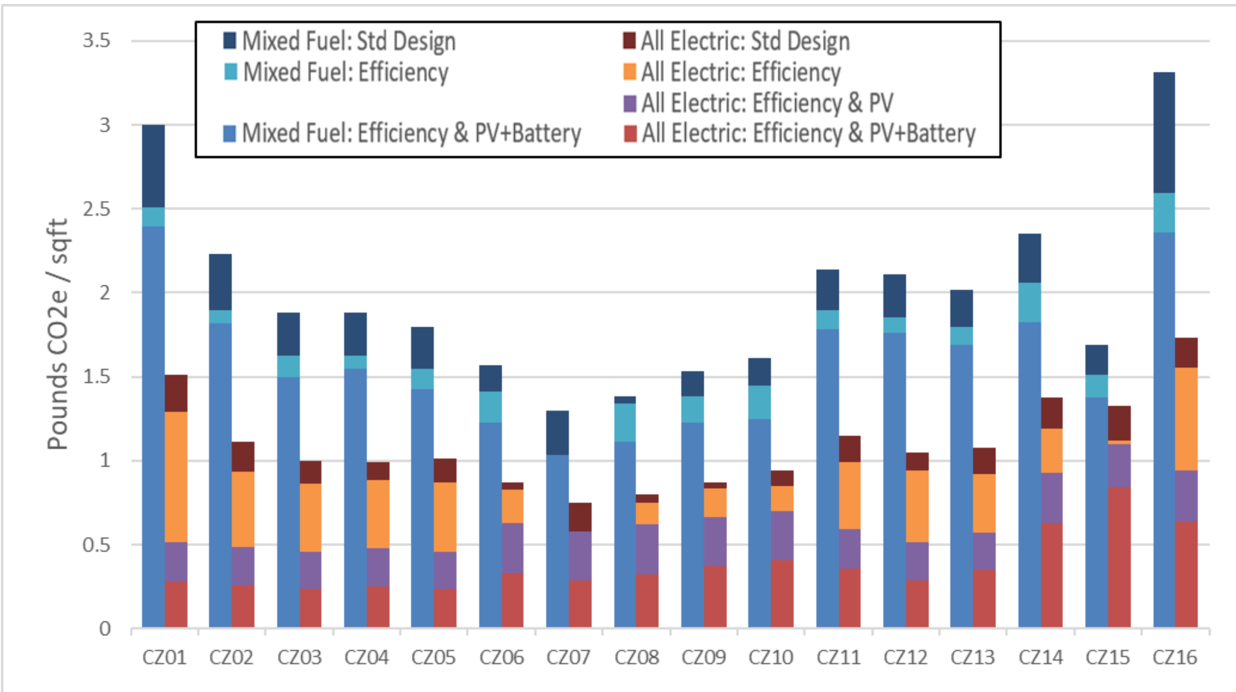

Figure 5: Single family greenhouse gas emissions comparison

3.3 Multifamily Results

Table 11 through Table 13 contain cost effectiveness findings for the multifamily packages. Table 11 summarizes the package costs for all the mixed fuel and all-electric efficiency, PV and battery packages.

Table 12 and Table 13 present the B/C ratios for all the packages according to both the On-Bill and TDV methodologies for the mixed fuel and the all-electric cases, respectively. All the packages are cost-effective based on TDV except Climate Zone 3 for the all-electric cases where no cost-effective combination of non-preempted efficiency measures was found that met the minimum 0.5 EDR Margin threshold. Cases where the B/C ratio is indicated as ">1" refer to instances where there are incremental cost savings in addition to annual utility bill savings. In these cases, there is no cost associated with this upgrade and benefits are realized immediately.

It is generally more challenging to achieve equivalent savings targets cost-effectively for the multifamily cases than for the single family cases. With less exterior surface area per floor area the impact of envelope measures is diminished in multifamily buildings. Ducts are already assumed to be within conditioned space and therefore only one of the duct measures found to be cost-effective in single family homes can be applied.

Figure 6 presents a comparison of Total EDRs for the multifamily cases and Figure 7 presents the EDR Margin results. Each graph compares the mixed fuel and all-electric cases as well as the various packages. Cost-effective efficiency packages were found for all **mixed fuel cases**. The Target EDR Margins for the **mixed fuel Efficiency Package** are 0.5 for Climate Zones 3, 5 and 7, between 1.0 and 2.5 for Climate Zones 1, 2, 4, 6, 8 through 12 and 16, and between 3.0 and 4.0 in Climate Zones 13 through 15. For the **all-electric case, no cost-effective non-preempted efficiency packages** were found in Climate Zone 3. The Target EDR Margins are between 0.5 and 2.5 for Climate Zones 2, 4 through 10 and 12, and between 3.0 and 4.0 in Climate Zones 1, 11, and 13 through 16.

For the **mixed fuel case, the Efficiency & PV/Battery Package** results in an EDR Margin of between 8.5 and 11.5 across all climate zones. Most of these packages were not found to be cost-effective based on utility bill savings alone, but they all are cost-effective based on TDV energy savings. For the **all-electric case, the Efficiency & PV Package** resulted in EDR Margins of 10.5 to 17.5 for most climates; adding a battery system increased the EDR Margin by an additional 10 to 15 points. Climate zones 1 and 16, which have high heating loads, have much higher EDR Margins for the **Efficiency & PV package** (19.5-22.5). The Standard Design PV, which is what is applied in the **Efficiency Package**, is not sized to offset any of the heating load. When the PV system is sized to offset 90% of the total electricity use, the increase is substantial as a result. In Climate Zone 15 the Standard Design PV system is already sized to cover the cooling electricity load, which represents 30% of whole building electricity use. Therefore, increasing the PV size to offset 90% of the electric load in this climate only results in adding approximately 240 Watts of PV capacity per apartment and subsequently a much smaller impact on the EDR than in other climate zones. Because of the limitations on oversizing PV systems to offset natural gas use it is not feasible to achieve comparable EDR Margins for the mixed fuel case as in the all-electric case.

Additional results details can be found in Appendix E – Multifamily Detailed Results with summaries of measures included in each of the packages in Appendix F – Multifamily Measure Summary. A summary of results by climate zone is presented in Appendix G – Results by Climate Zone.

Table 11: Multifamily Package Incremental Costs per Dwelling Unit

Climate Zone	Mixed Fuel			All-Electric			
	Non-Preempted	Equipment - Preempted	Efficiency & PV/Battery	Non-Preempted	Equipment - Preempted	Efficiency & PV	Efficiency & PV/Battery
CZ01	+$960	+$507	+$3,094	+$949	+$795	+$5,538	+$8,919
CZ02	+$309	+$497	+$2,413	+$361	+$795	+$3,711	+$6,833
CZ03	+$175	+$403	+$2,279	n/a	+$795	+$3,272	+$6,344
CZ04	+$329	+$351	+$2,429	+$361	+$795	+$3,158	+$6,201
CZ05	+$180	+$358	+$2,273	+$247	+$795	+$3,293	+$6,314
CZ06	+$190	+$213	+$2,294	+$231	+$361	+$2,580	+$5,590
CZ07	+$90	+$366	+$2,188	+$202	+$361	+$2,261	+$5,203
CZ08	+$250	+$213	+$2,353	+$231	+$361	+$2,240	+$5,249
CZ09	+$136	+$274	+$2,234	+$231	+$361	+$2,232	+$5,236
CZ10	+$278	+$250	+$2,376	+$361	+$361	+$2,371	+$5,395
CZ11	+$850	+$317	+$2,950	+$1,011	+$795	+$3,601	+$6,759
CZ12	+$291	+$434	+$2,394	+$1,011	+$795	+$3,835	+$6,943
CZ13	+$831	+$290	+$2,936	+$1,011	+$795	+$3,462	+$6,650
CZ14	+$874	+$347	+$2,957	+$1,011	+$795	+$3,356	+$6,380
CZ15	+$510	-($157)	+$2,604	+$1,011	+$1,954	+$1,826	+$5,020
CZ16	+$937	+$453	+$3,028	+$843	+$795	+$4,423	+$7,533

Table 12: Multifamily Package Cost-Effectiveness Results for the Mixed Fuel Case[1,2]

		Efficiency							Efficiency & PV/Battery			
		Non-Preempted			Equipment - Preempted			Target				Target
CZ	Utility	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR Margin
01	PG&E	3.4	1.1	1.2	2.3	1.3	1.4	2.0	11.5	0.4	1.2	11.5
02	PG&E	1.8	1.0	1.7	2.3	1.1	1.5	1.5	10.9	0.2	1.6	10.5
03	PG&E	0.6	1.0	1.1	1.6	1.1	1.2	0.5	10.3	0.1	1.4	10.0
04	PG&E	1.3	0.8	1.2	1.9	1.1	1.7	1.0	11.2	0.2	1.6	11.0
05	PG&E	0.5	1.0	1.0	1.5	1.2	1.3	0.5	9.9	0.2	1.4	9.5
05	PG&E/SoCalGas	0.5	0.8	1.0	1.5	1.1	1.3	0.5	9.9	0.1	1.4	9.5
06	SCE/SoCalGas	1.3	0.6	1.5	1.3	1.4	1.7	1.0	10.7	0.6	1.4	10.5
07	SDG&E	0.9	0.7	2.2	2.0	1.1	1.4	0.5	11.0	0.0	1.4	11.0
08	SCE/SoCalGas	1.5	0.7	1.4	1.1	1.4	1.7	1.0	9.9	0.7	1.3	9.5
09	SCE/SoCalGas	1.8	1.5	3.3	2.8	1.7	2.9	1.5	9.7	0.9	1.5	9.5
10	SCE/SoCalGas	1.7	0.8	1.7	2.9	2.0	3.3	1.5	10.4	1.0	1.6	10.0
10	SDG&E	1.7	1.1	1.7	2.9	2.6	3.3	1.5	10.4	0.2	1.6	10.0
11	PG&E	2.9	0.7	1.2	3.2	1.8	3.3	2.5	10.5	0.4	1.6	10.5
12	PG&E	1.9	1.1	2.2	2.8	1.2	2.2	1.5	10.3	0.3	1.7	10.0
13	PG&E	3.1	0.6	1.3	3.4	2.0	3.8	3.0	10.7	0.4	1.6	10.5
14	SCE/SoCalGas	3.1	0.7	1.2	3.3	2.0	3.0	3.0	9.6	1.1	1.4	9.5
14	SDG&E	3.1	0.9	1.2	3.3	2.5	3.0	3.0	9.6	0.5	1.4	9.5
15	SCE/SoCalGas	4.2	1.4	2.3	4.4	>1	>1	4.0	8.8	1.3	1.7	8.5
16	PG&E	2.4	1.1	1.2	2.9	1.8	2.1	2.0	9.9	0.5	1.3	9.5

[1]“>1” indicates cases where there are both first cost savings and annual utility bill savings.

[2]Information about the measures included for each climate zone are described in Appendix F – Multifamily Measure Summary.

Table 13: Multifamily Package Cost-effectiveness Results for the All-Electric Case[1,2]

		Efficiency							Efficiency & PV				Efficiency & PV/Battery			
		Non-Preempted			Equipment - Preempted											
CZ	Utility	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Target Efficiency EDR Margin	Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Target Total EDR Margin	Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Target Total EDR Margin
01	PG&E	3.6	1.6	1.4	3.3	2.4	2.3	3.0	22.5	2.0	1.5	22.5	34.5	1.3	1.4	34.5
02	PG&E	1.9	1.7	2.1	3.2	1.6	1.6	1.5	17.5	2.4	1.8	17.5	30.9	1.4	1.7	30.5
03	PG&E	0.0	-	-	2.7	1.7	1.6	0.0	16.1	2.4	1.7	16.0	29.5	1.3	1.6	29.5
04	PG&E	1.4	1.4	1.5	2.2	1.2	1.1	1.0	15.0	2.4	1.8	15.0	28.9	1.3	1.8	28.5
05	PG&E	0.6	1.1	0.9	3.6	2.1	2.0	0.5	17.1	2.5	1.8	17.0	30.3	1.4	1.7	30.0
05	PG&E/SoCalGas	0.6	1.1	0.9	3.6	2.1	2.0	0.5	17.1	2.5	1.8	17.0	30.3	1.4	1.7	30.0
06	SCE/SoCalGas	1.0	0.7	1.3	2.2	1.6	1.9	1.0	13.8	1.2	1.7	13.5	27.5	1.2	1.6	27.5
07	SDG&E	0.6	0.6	1.0	1.9	1.6	1.7	0.5	12.8	2.1	1.8	12.5	27.1	1.2	1.6	27.0
08	SCE/SoCalGas	1.2	0.9	1.7	1.9	1.6	1.8	1.0	11.6	1.3	1.8	11.5	24.2	1.2	1.6	24.0
09	SCE/SoCalGas	1.6	1.3	2.7	1.5	1.6	1.6	1.5	11.3	1.3	1.9	11.0	23.3	1.3	1.7	23.0
10	SCE/SoCalGas	1.8	1.2	2.0	1.8	1.7	2.0	1.5	10.8	1.3	1.8	10.5	23.3	1.3	1.7	23.0
10	SDG&E	1.8	1.5	2.0	1.8	2.0	2.0	1.5	10.8	2.1	1.8	10.5	23.3	1.4	1.7	23.0
11	PG&E	3.5	1.4	1.6	3.9	2.0	2.3	3.5	13.4	2.2	1.8	13.0	25.3	1.4	1.8	25.0
12	PG&E	2.6	0.9	1.1	2.9	1.6	1.6	2.5	14.4	2.1	1.6	14.0	26.6	1.3	1.7	26.5
13	PG&E	3.3	1.3	1.6	3.8	2.0	2.3	3.0	12.2	2.1	1.7	12.0	23.9	1.4	1.7	23.5
14	SCE/SoCalGas	3.7	1.2	1.6	3.8	1.6	2.2	3.5	14.0	1.4	1.9	14.0	24.8	1.4	1.8	24.5
14	SDG&E	3.7	1.5	1.6	3.8	2.0	2.2	3.5	14.0	2.2	1.9	14.0	24.8	1.7	1.8	24.5
15	SCE/SoCalGas	4.4	1.5	2.3	6.4	1.2	1.7	4.0	7.1	1.4	2.1	7.0	16.9	1.3	1.8	16.5
16	PG&E	4.1	2.1	2.1	3.2	1.6	1.7	3.0	19.6	2.6	1.9	19.5	29.9	1.6	1.7	29.5

[1] ">1" indicates cases where there are both first cost savings and annual utility bill savings.
[2] Information about the measures included for each climate zone are described in Appendix F – Multifamily Measure Summary.

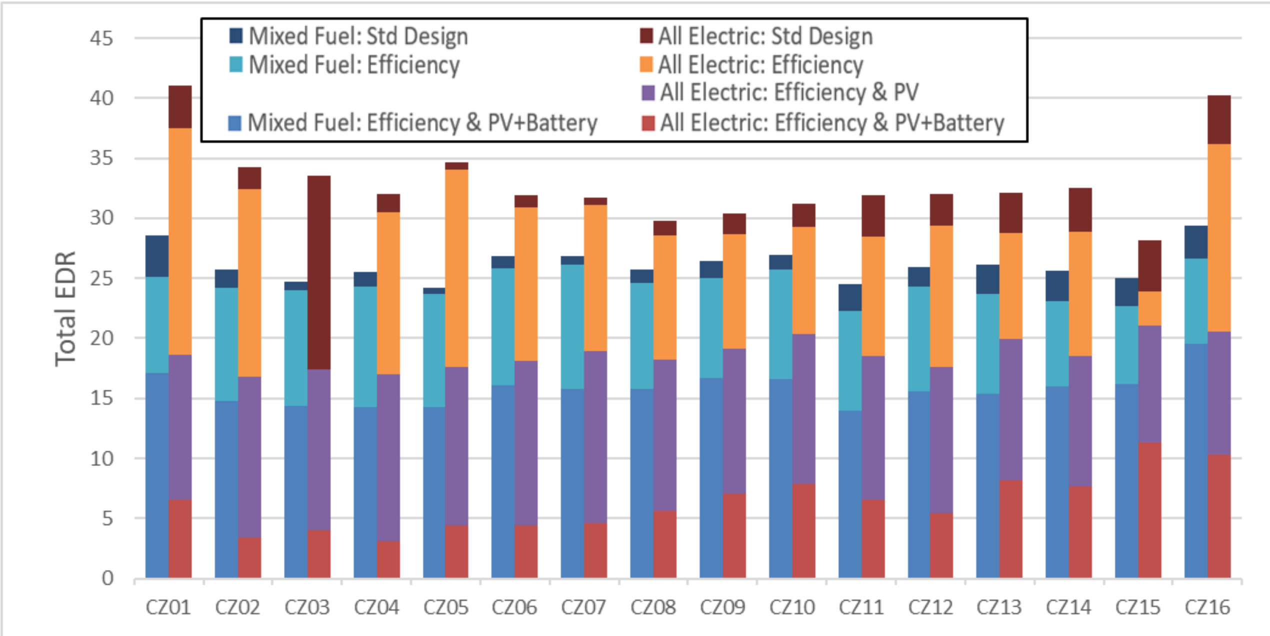

Figure 6: Multifamily Total EDR comparison

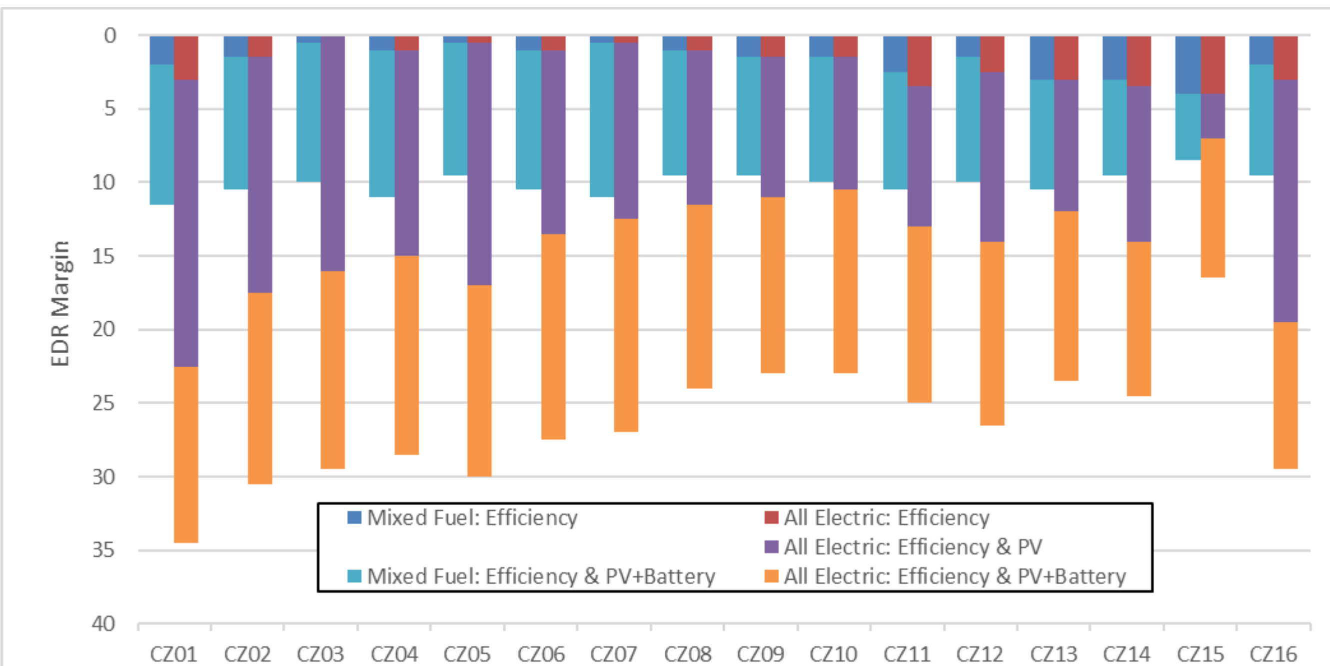

Figure 7: Multifamily EDR Margin comparison (based on Efficiency EDR Margin for the Efficiency packages and the Total EDR Margin for the Efficiency & PV and Efficiency & PV/Battery packages)

3.3.1 GHG Emission Reductions

Figure 8 compares annual GHG emissions for both mixed fuel and all-electric multifamily 2019 code compliant cases with Efficiency, Efficiency & PV and Efficiency & PV/Battery packages. GHG emissions vary by climate but are consistently higher in mixed fuel cases than all-electric. Standard design mixed fuel emissions range from 2.0 to 3.0 lbs CO2e/square foot of floor area, where all-electric standard design emissions range from 1.2 to 1.7 lbs CO2e/ ft^2. Adding PV, batteries and efficiency to the mixed fuel code compliant prototype reduces annual GHG emissions by 17% on average to between 1.7 and 2.2 lbs CO2e/ft^2, except Climate Zone 16. Adding PV, batteries and efficiency to the all-electric code compliant prototype reduces annual GHG emissions by 64% on average to 0.6 lbs CO2e/ft^2 or less with the exception of Climate Zones 14, 15 and 16. As in the single family case, none of the cases completely eliminate GHG emissions because of the time value of emissions calculation for electricity in CBECC-Res.

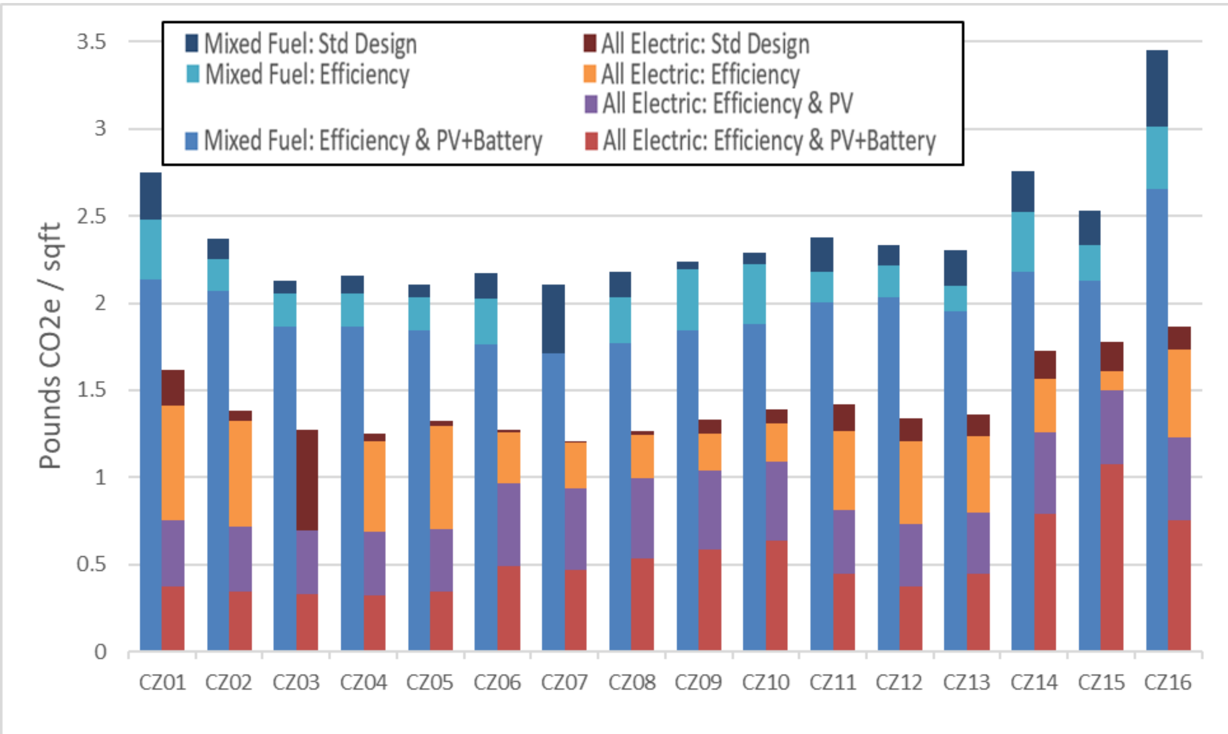

Figure 8: Multifamily greenhouse gas emissions comparison

3.4 Electrification Results

Cost-effectiveness results comparing mixed fuel and all-electric cases are summarized below. The tables show average annual utility bill impacts and lifetime utility bill impacts, which account for fuel escalation for electricity and natural gas (see Section 2.5), lifetime equipment cost savings, and both On-Bill and TDV cost-effectiveness (B/C ratio). Positive utility bill values indicate lower utility costs for the all-electric home relative to the mixed fuel case while negative values in red and parenthesis indicate higher utility costs for the all-electric case. Lifetime equipment cost savings include savings due to eliminating natural gas infrastructure and replacement costs for appliances based on equipment life. Positive values for the lifetime equipment cost savings indicate lower installed costs for the all-electric and negative values indicate higher costs. B/C ratios 1.0 or greater indicate positive cost-effectiveness. Cases where the B/C ratio is indicated as ">1" refer to instances where there was incremental cost savings in addition to annual utility bill savings. In these cases, there is no cost associated with this upgrade and benefits are realized immediately.

Three scenarios were evaluated:

1. 2019 Code Compliant: Compares a 2019 code compliant all-electric home with a 2019 code compliant mixed fuel home.
2. Efficiency & PV Package: Compares an all-electric home with efficiency and PV sized to 90% of the annual electricity use to a 2019 code compliant mixed fuel home. The first cost savings in the code compliant all-electric house is invested in above code efficiency and PV reflective of the Efficiency & PV packages described above.
3. Neutral Cost Package: Compares an all-electric home with PV beyond code minimum with a 2019 code compliant mixed fuel home. The PV system for the all-electric case is sized to result in a zero lifetime incremental cost relative to a mixed fuel home.

3.4.1 Single Family

Table 14, Table 15, Figure 9, Figure 10, and Figure 11 present results of cost-effectiveness analysis for electrification of single family buildings, according to both the On-Bill and TDV methodologies. Based on typical cost assumptions arrived at for this analysis, the lifetime equipment costs for the single family code compliant all-electric option are approximately $5,350 less than the mixed fuel code compliant option. Cost savings are entirely due to the elimination of gas infrastructure, which was assumed to be a savings of $5,750. When evaluating cost-effectiveness based on TDV, the Utility Gas Main Extensions rules 50% refund and appliance allowance deduction are not applied and therefore the cost savings are twice as much.

Under the Efficiency & PV Package and the On-Bill analysis, the incremental cost of the efficiency and PV is typically more than the cost savings seen in the code compliant case, which results in a net cost increase in most climate zones for the all-electric case. In climates with small heating loads (7 and 15) there continues to be an incremental cost savings for the all-electric home. With the TDV analysis, there is still an incremental cost savings in all climates except 1 and 16 for single family.

Utility impacts differ by climate zone and utility, but utility costs for the code compliant all-electric option are typically higher than for the compliant mixed fuel design. There are utility cost savings across all climates zones and building types for the all-electric Efficiency & PV Package, resulting in a more cost-effective option.

The all-electric code compliant option is cost-effective based on the On-Bill approach for single family homes in Climate Zones 6 through 9, 10 (SCE/SoCalGas territory only), and 15. The code compliant option is cost-effective based on the TDV methodology in all climate zones except 1 and 16. If the same costs used for the On-Bill approach are also used for the TDV approach (incorporating the Utility Gas Main Extensions rules 50% refund and appliance allowance deduction), the all-electric code compliant option is cost-effective in Climate Zones 6 through 10. The Efficiency & PV all-electric option is cost-effective in all climate zones based on both the On-Bill and TDV methodologies. In many cases it is cost-effective immediately with lower equipment and utility costs.

The last set of results in Table 14 shows the neutral cost case where the cost savings for the all-electric code compliant home is invested in a larger PV system, resulting in a lifetime incremental cost of zero based on the On-Bill approach. This package results in utility cost savings in all cases except Climate Zones 1, 14 (SCE/SoCalGas territory only), and 16. For these three cases the Reach Code Team evaluated how much additional PV would be required to result in a cost-effective package. These results are presented in Table 15 and show that an additional 1.6kW in Climate Zone 1 results in a B/C ratio of 1.1. For Climate Zone 14 and 16 adding 0.25kW and 1.2kW, respectively, results in a B/C ratio of 1.2. Neutral cost cases are cost-effective based on the TDV methodology in all climate zones except 16.

3.4.2 Multifamily

Multifamily results are found in Table 16, Table 17, Figure 12, Figure 13, and Figure 14. Lifetime costs for the multifamily code compliant all-electric option are approximately $2,300 less than the mixed fuel code compliant option, entirely due to the elimination of gas infrastructure. When evaluating cost-effectiveness based on TDV, the Utility Gas Main Extensions rules 50% refund and appliance allowance deduction are not applied and therefore the cost savings are approximately 2.5 times higher.

With the Efficiency & PV Package and the On-Bill analysis, due to the added cost of the efficiency and PV there is a net cost increase for the all-electric case in all climate zones for except 7, 8, 9, and 15. With the TDV analysis, there is still an incremental cost savings in all climates. Like the single family results, utility costs are typically higher for the code compliant all-electric option but lower than the code compliant mixed fuel option with the Efficiency & PV Package.

The all-electric code compliant option is cost-effective based on the On-Bill approach for multifamily in Climate Zones 6 through 9, 10 and 14 (SCE/SoCalGas territory only), and 15. Based on the TDV methodology, the code compliant option for multifamily is cost-effective for all climate zones. If the same costs used for the On-Bill approach are also used for the TDV approach (incorporating the Utility Gas Main Extensions rules 50% refund and appliance allowance deduction), the all-electric code compliant option is cost-effective in Climate Zones 8 and 9. Like the single family cases, the Efficiency & PV all-electric option is cost-effective in all climate zones based on both the On-Bill and TDV methodologies.

The last set of results in Table 16 show the neutral cost case where the cost savings for the all-electric code compliant home is invested in a larger PV system, resulting in a lifetime incremental cost of zero based on the On-Bill approach. This package results in utility cost savings in all cases except Climate Zone 1. For this case the Reach Code Team evaluated how much additional PV would be required to result in a cost-effective package. These results are presented in Table 17 and show that an additional 0.3kW per apartment results in a B/C ratio of 1.1. Neutral cost cases are cost-effective based on the TDV methodology in all climate zones except 16.

Table 14: Single Family Electrification Results

		On-Bill Cost-effectiveness[1]						TDV Cost-effectiveness		
		Average Annual Utility Bill Savings			Lifetime NPV			Lifetime NPV		
CZ	Utility	Electricity	Natural Gas	Net Utility Savings	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio[2]	TDV Cost Savings	Equipment Cost Savings	TDV B/C Ratio
	2019 Code Compliant Home									
01	PG&E	-($1,194)	+$712	-($482)	-($14,464)	+$5,349	0.4	-($13,081)	+$11,872	0.9
02	PG&E	-($825)	+$486	-($340)	-($10,194)	+$5,349	0.5	-($7,456)	+$11,872	1.6
03	PG&E	-($717)	+$391	-($326)	-($9,779)	+$5,349	0.5	-($7,766)	+$11,872	1.5
04	PG&E	-($710)	+$387	-($322)	-($9,671)	+$5,349	0.6	-($7,447)	+$11,872	1.6
05	PG&E	-($738)	+$367	-($371)	-($11,128)	+$5,349	0.5	-($8,969)	+$11,872	1.3
05	PG&E/SoCalGas	-($738)	+$370	-($368)	-($11,034)	+$5,349	0.5	-($8,969)	+$11,872	1.3
06	SCE/SoCalGas	-($439)	+$289	-($149)	-($4,476)	+$5,349	1.2	-($4,826)	+$11,872	2.5
07	SDG&E	-($414)	+$243	-($171)	-($5,134)	+$5,349	1.0	-($4,678)	+$11,872	2.5
08	SCE/SoCalGas	-($347)	+$249	-($97)	-($2,921)	+$5,349	1.8	-($3,971)	+$11,872	3.0
09	SCE/SoCalGas	-($377)	+$271	-($107)	-($3,199)	+$5,349	1.7	-($4,089)	+$11,872	2.9
10	SCE/SoCalGas	-($403)	+$280	-($123)	-($3,684)	+$5,349	1.5	-($4,458)	+$11,872	2.7
10	SDG&E	-($496)	+$297	-($198)	-($5,950)	+$5,349	0.9	-($4,458)	+$11,872	2.7
11	PG&E	-($810)	+$447	-($364)	-($10,917)	+$5,349	0.5	-($7,024)	+$11,872	1.7
12	PG&E	-($740)	+$456	-($284)	-($8,533)	+$5,349	0.6	-($6,281)	+$11,872	1.9
13	PG&E	-($742)	+$413	-($329)	-($9,870)	+$5,349	0.5	-($6,480)	+$11,872	1.8
14	SCE/SoCalGas	-($661)	+$413	-($248)	-($7,454)	+$5,349	0.7	-($7,126)	+$11,872	1.7
14	SDG&E	-($765)	+$469	-($296)	-($8,868)	+$5,349	0.6	-($7,126)	+$11,872	1.7
15	SCE/SoCalGas	-($297)	+$194	-($103)	-($3,090)	+$5,349	1.7	-($5,364)	+$11,872	2.2
16	PG&E	-($1,287)	+$712	-($575)	-($17,250)	+$5,349	0.3	-($17,391)	+$11,872	0.7

		On-Bill Cost-effectiveness[1]						TDV Cost-effectiveness		
		Average Annual Utility Bill Savings			Lifetime NPV			Lifetime NPV		
CZ	Utility	Electricity	Natural Gas	Net Utility Savings	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio[2]	TDV Cost Savings	Equipment Cost Savings	TDV B/C Ratio
	Efficiency & PV Package									
01	PG&E	-($99)	+$712	+$613	+$18,398	-($12,844)	1.4	+$13,364	-($6,321)	2.1
02	PG&E	-($89)	+$486	+$397	+$11,910	-($6,758)	1.8	+$9,307	-($234)	39.7
03	PG&E	-($87)	+$391	+$304	+$9,119	-($3,169)	2.9	+$6,516	+$3,355	>1
04	PG&E	-($85)	+$387	+$302	+$9,074	-($3,438)	2.6	+$6,804	+$3,086	>1
05	PG&E	-($98)	+$367	+$268	+$8,054	-($2,959)	2.7	+$5,625	+$3,564	>1
05	PG&E/SoCalGas	-($98)	+$370	+$272	+$8,148	-($2,959)	2.8	+$5,625	+$3,564	>1
06	SCE/SoCalGas	-($188)	+$289	+$102	+$3,049	-($992)	3.1	+$4,585	+$5,531	>1
07	SDG&E	-($137)	+$243	+$106	+$3,174	+$912	>1	+$2,176	+$7,436	>1
08	SCE/SoCalGas	-($160)	+$249	+$89	+$2,664	-($25)	107.9	+$3,965	+$6,499	>1
09	SCE/SoCalGas	-($169)	+$271	+$102	+$3,067	-($429)	7.1	+$5,368	+$6,094	>1
10	SCE/SoCalGas	-($173)	+$280	+$107	+$3,216	-($1,057)	3.0	+$5,165	+$5,466	>1
10	SDG&E	-($137)	+$297	+$160	+$4,805	-($1,057)	4.5	+$5,165	+$5,466	>1
11	PG&E	-($147)	+$447	+$300	+$8,988	-($5,478)	1.6	+$9,776	+$1,045	>1
12	PG&E	-($92)	+$456	+$364	+$10,918	-($6,172)	1.8	+$9,913	+$352	>1
13	PG&E	-($144)	+$413	+$269	+$8,077	-($5,184)	1.6	+$8,960	+$1,339	>1
14	SCE/SoCalGas	-($241)	+$413	+$172	+$5,164	-($5,111)	1.0	+$9,850	+$1,412	>1
14	SDG&E	-($139)	+$469	+$330	+$9,910	-($5,111)	1.9	+$9,850	+$1,412	>1
15	SCE/SoCalGas	-($107)	+$194	+$87	+$2,603	+$264	>1	+$2,598	+$6,787	>1
16	PG&E	-($130)	+$712	+$582	+$17,457	-($11,234)	1.6	+$9,536	-($4,710)	2.0
	Neutral Cost Package									
01	PG&E	-($869)	+$712	-($157)	-($4,704)	+$0	0	-($6,033)	+$6,549	1.1
02	PG&E	-($445)	+$486	+$40	+$1,213	+$0	>1	+$868	+$6,505	>1
03	PG&E	-($335)	+$391	+$56	+$1,671	+$0	>1	+$483	+$6,520	>1
04	PG&E	-($321)	+$387	+$66	+$1,984	+$0	>1	+$1,062	+$6,521	>1
05	PG&E	-($335)	+$367	+$31	+$938	+$0	>1	-($163)	+$6,519	40.1
05	PG&E/SoCalGas	-($335)	+$370	+$34	+$1,031	+$0	>1	-($163)	+$6,519	40.1
06	SCE/SoCalGas	-($227)	+$289	+$63	+$1,886	+$0	>1	+$3,258	+$6,499	>1
07	SDG&E	-($72)	+$243	+$171	+$5,132	+$0	>1	+$3,741	+$6,519	>1
08	SCE/SoCalGas	-($144)	+$249	+$105	+$3,162	+$0	>1	+$4,252	+$6,515	>1
09	SCE/SoCalGas	-($170)	+$271	+$100	+$3,014	+$0	>1	+$4,271	+$6,513	>1
10	SCE/SoCalGas	-($199)	+$280	+$81	+$2,440	+$0	>1	+$3,629	+$6,494	>1
10	SDG&E	-($155)	+$297	+$143	+$4,287	+$0	>1	+$3,629	+$6,494	>1
11	PG&E	-($426)	+$447	+$21	+$630	+$0	>1	+$1,623	+$6,504	>1
12	PG&E	-($362)	+$456	+$94	+$2,828	+$0	>1	+$2,196	+$6,525	>1
13	PG&E	-($370)	+$413	+$43	+$1,280	+$0	>1	+$1,677	+$6,509	>1
14	SCE/SoCalGas	-($416)	+$413	-($4)	-($107)	+$0	0	+$2,198	+$6,520	>1
14	SDG&E	-($391)	+$469	+$79	+$2,356	+$0	>1	+$2,198	+$6,520	>1
15	SCE/SoCalGas	-($98)	+$194	+$97	+$2,900	+$0	>1	+$2,456	+$6,483	>1
16	PG&E	-($878)	+$712	-($166)	-($4,969)	+$0	0	-($8,805)	+$6,529	0.7

[1]Red values in parentheses indicate an increase in utility bill costs or an incremental first cost for the all-electric home.
[2]“>1” indicates cases where there are both first cost savings and annual utility bill savings.

Table 15: Comparison of Single Family On-Bill Cost Effectiveness Results with Additional PV

		Neutral Cost				Min. Cost Effectiveness			
CZ	Utility	PV Capacity (kW)	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio	PV Capacity (kW)	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio
01	PG&E	4.7	-($4,704)	+$0	0	6.3	+$6,898	-($6,372)	1.1
14	SCE/SoCalGas	4.5	-($107)	+$0	0	4.8	+$1,238	-($1,000)	1.2
16	PG&E	4.1	-($4,969)	+$0	0	5.3	+$5,883	-($4,753)	1.2

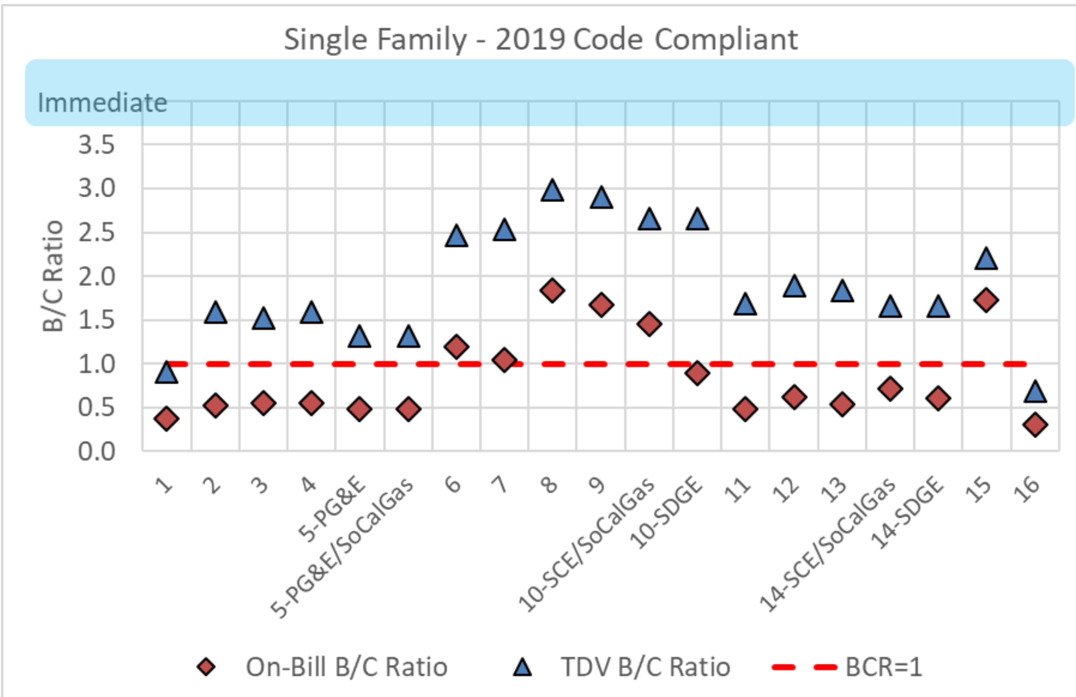

Figure 9: B/C ratio results for a single family all-electric code compliant home versus a mixed fuel code compliant home

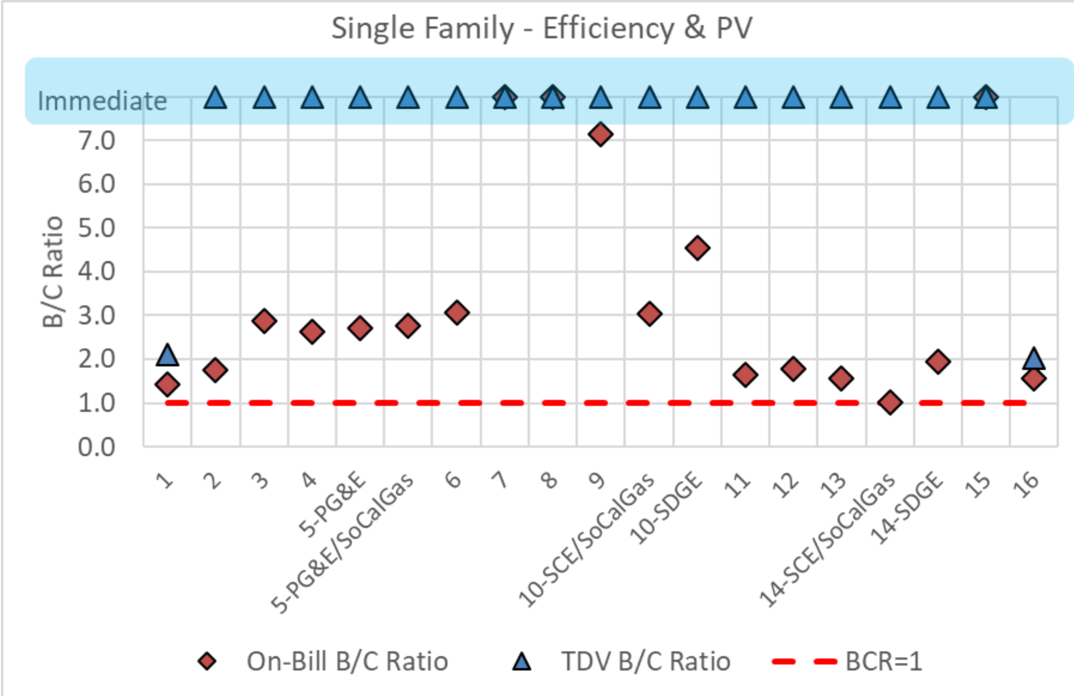

Figure 10: B/C ratio results for the single family Efficiency & PV all-electric home versus a mixed fuel code compliant home

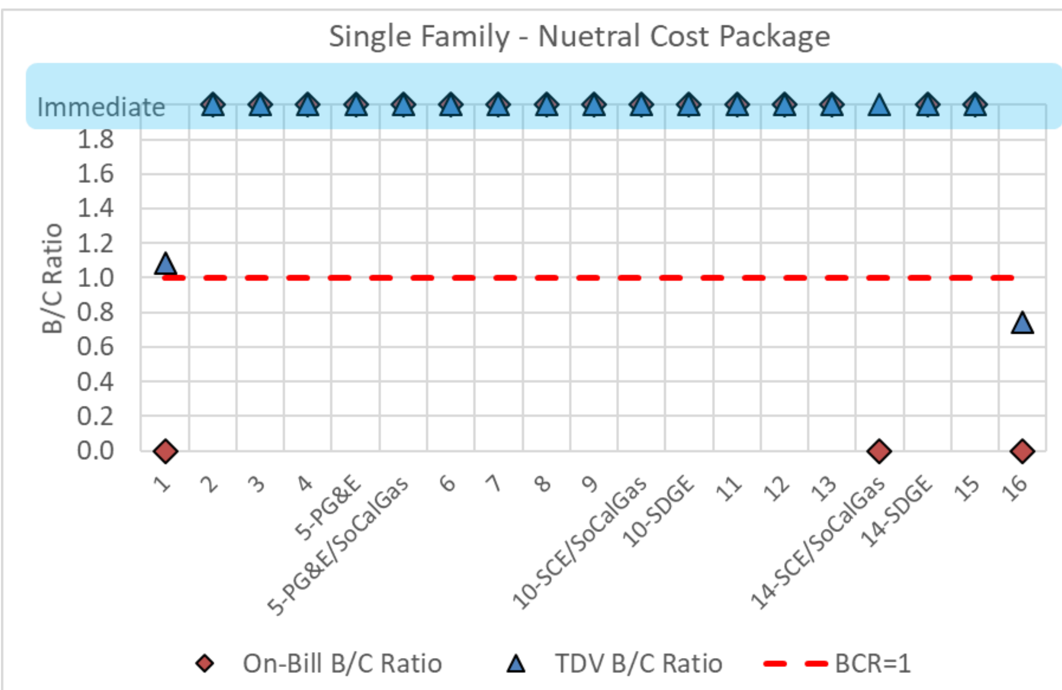

Figure 11: B/C ratio results for the single family neutral cost package all-electric home versus a mixed fuel code compliant home

Table 16: Multifamily Electrification Results (Per Dwelling Unit)

		On-Bill Cost-effectiveness[1]						TDV Cost-effectiveness		
		Average Annual Utility Bill Savings			Lifetime NPV			Lifetime NPV		
CZ	Utility	Electricity	Natural Gas	Net Utility Savings	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio[2]	TDV Cost Savings	Equipment Cost Savings	TDV B/C Ratio
	2019 Code Compliant Home									
01	PG&E	-($396)	+$193	-($203)	-($6,079)	+$2,337	0.4	-($5,838)	+$5,899	1.0
02	PG&E	-($310)	+$162	-($148)	-($4,450)	+$2,337	0.5	-($4,144)	+$5,899	1.4
03	PG&E	-($277)	+$142	-($135)	-($4,041)	+$2,337	0.6	-($4,035)	+$5,899	1.5
04	PG&E	-($264)	+$144	-($120)	-($3,595)	+$2,337	0.6	-($3,329)	+$5,899	1.8
05	PG&E	-($297)	+$140	-($157)	-($4,703)	+$2,337	0.5	-($4,604)	+$5,899	1.3
05	PG&E/SoCalGas	-($297)	+$178	-($119)	-($3,573)	+$2,337	0.7	-($4,604)	+$5,899	1.3
06	SCE/SoCalGas	-($191)	+$161	-($30)	-($902)	+$2,337	2.6	-($2,477)	+$5,899	2.4
07	SDG&E	-($206)	+$136	-($70)	-($2,094)	+$2,337	1.1	-($2,390)	+$5,899	2.5
08	SCE/SoCalGas	-($169)	+$157	-($12)	-($349)	+$2,337	6.7	-($2,211)	+$5,899	2.7
09	SCE/SoCalGas	-($177)	+$159	-($18)	-($533)	+$2,337	4.4	-($2,315)	+$5,899	2.5
10	SCE/SoCalGas	-($183)	+$159	-($23)	-($697)	+$2,337	3.4	-($2,495)	+$5,899	2.4
10	SDG&E	-($245)	+$139	-($106)	-($3,192)	+$2,337	0.7	-($2,495)	+$5,899	2.4
11	PG&E	-($291)	+$153	-($138)	-($4,149)	+$2,337	0.6	-($4,420)	+$5,899	1.3
12	PG&E	-($277)	+$155	-($122)	-($3,665)	+$2,337	0.6	-($3,557)	+$5,899	1.7
13	PG&E	-($270)	+$146	-($124)	-($3,707)	+$2,337	0.6	-($3,821)	+$5,899	1.5
14	SCE/SoCalGas	-($255)	+$187	-($69)	-($2,062)	+$2,337	1.1	-($3,976)	+$5,899	1.5
14	SDG&E	-($328)	+$175	-($154)	-($4,607)	+$2,337	0.5	-($3,976)	+$5,899	1.5
15	SCE/SoCalGas	-($154)	+$142	-($12)	-($367)	+$2,337	6.4	-($2,509)	+$5,899	2.4
16	PG&E	-($404)	+$224	-($180)	-($5,411)	+$2,337	0.4	-($5,719)	+$5,899	1.0
	Efficiency & PV Package									
01	PG&E	-($19)	+$193	+$174	+$5,230	-($3,202)	1.6	+$2,467	+$361	>1
02	PG&E	-($10)	+$162	+$152	+$4,549	-($1,375)	3.3	+$2,605	+$2,187	>1
03	PG&E	-($12)	+$142	+$130	+$3,910	-($936)	4.2	+$1,632	+$2,626	>1
04	PG&E	-($8)	+$144	+$136	+$4,080	-($822)	5.0	+$2,381	+$2,740	>1
05	PG&E	-($19)	+$140	+$121	+$3,635	-($956)	3.8	+$1,403	+$2,606	>1
05	PG&E/SoCalGas	-($19)	+$178	+$159	+$4,765	-($956)	5.0	+$1,403	+$2,606	>1
06	SCE/SoCalGas	-($84)	+$161	+$77	+$2,309	-($243)	9.5	+$1,940	+$3,319	>1
07	SDG&E	-($49)	+$136	+$87	+$2,611	+$75	>1	+$1,583	+$3,638	>1
08	SCE/SoCalGas	-($74)	+$157	+$83	+$2,480	+$96	>1	+$1,772	+$3,658	>1
09	SCE/SoCalGas	-($76)	+$159	+$82	+$2,469	+$104	>1	+$1,939	+$3,667	>1
10	SCE/SoCalGas	-($79)	+$159	+$80	+$2,411	-($34)	70.9	+$1,737	+$3,528	>1
10	SDG&E	-($77)	+$139	+$61	+$1,842	-($34)	54.2	+$1,737	+$3,528	>1
11	PG&E	-($25)	+$153	+$128	+$3,834	-($1,264)	3.0	+$2,080	+$2,298	>1
12	PG&E	-($11)	+$155	+$144	+$4,316	-($1,498)	2.9	+$2,759	+$2,064	>1
13	PG&E	-($26)	+$146	+$121	+$3,625	-($1,125)	3.2	+$2,083	+$2,437	>1
14	SCE/SoCalGas	-($99)	+$187	+$87	+$2,616	-($1,019)	2.6	+$2,422	+$2,543	>1
14	SDG&E	-($86)	+$175	+$88	+$2,647	-($1,019)	2.6	+$2,422	+$2,543	>1
15	SCE/SoCalGas	-($67)	+$142	+$75	+$2,247	+$511	>1	+$1,276	+$4,073	>1
16	PG&E	-($24)	+$224	+$200	+$5,992	-($2,087)	2.9	+$2,629	+$1,476	>1

		On-Bill Cost-effectiveness[1]						TDV Cost-effectiveness		
		Average Annual Utility Bill Savings			Lifetime NPV			Lifetime NPV		
CZ	Utility	Electricity	Natural Gas	Net Utility Savings	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio[2]	TDV Cost Savings	Equipment Cost Savings	TDV B/C Ratio
	Neutral Cost Package									
01	PG&E	-($228)	+$193	-($35)	-($1,057)	+$0	0	-($2,267)	+$3,564	1.6
02	PG&E	-($115)	+$162	+$47	+$1,399	+$0	>1	+$59	+$3,563	>1
03	PG&E	-($81)	+$142	+$61	+$1,843	+$0	>1	+$138	+$3,562	>1
04	PG&E	-($64)	+$144	+$80	+$2,402	+$0	>1	+$983	+$3,563	>1
05	PG&E	-($90)	+$140	+$50	+$1,490	+$0	>1	-($152)	+$3,564	23.4
05	PG&E/SoCalGas	-($90)	+$178	+$87	+$2,620	+$0	>1	-($152)	+$3,564	23.4
06	SCE/SoCalGas	-($90)	+$161	+$71	+$2,144	+$0	>1	+$1,612	+$3,562	>1
07	SDG&E	-($32)	+$136	+$105	+$3,135	+$0	>1	+$1,886	+$3,560	>1
08	SCE/SoCalGas	-($67)	+$157	+$90	+$2,705	+$0	>1	+$1,955	+$3,564	>1
09	SCE/SoCalGas	-($71)	+$159	+$87	+$2,623	+$0	>1	+$1,924	+$3,561	>1
10	SCE/SoCalGas	-($78)	+$159	+$81	+$2,431	+$0	>1	+$1,588	+$3,561	>1
10	SDG&E	-($71)	+$139	+$68	+$2,033	+$0	>1	+$1,588	+$3,561	>1
11	PG&E	-($93)	+$153	+$59	+$1,783	+$0	>1	-($48)	+$3,562	74.0
12	PG&E	-($82)	+$155	+$73	+$2,184	+$0	>1	+$739	+$3,564	>1
13	PG&E	-($79)	+$146	+$68	+$2,034	+$0	>1	+$310	+$3,560	>1
14	SCE/SoCalGas	-($141)	+$187	+$45	+$1,359	+$0	>1	+$747	+$3,562	>1
14	SDG&E	-($137)	+$175	+$38	+$1,131	+$0	>1	+$747	+$3,562	>1
15	SCE/SoCalGas	-($50)	+$142	+$92	+$2,771	+$0	>1	+$1,738	+$3,560	>1
16	PG&E	-($194)	+$224	+$30	+$900	+$0	>1	-($1,382)	+$3,564	2.6

[1]Red values in parentheses indicate an increase in utility bill costs or an incremental first cost for the all-electric home.
[2]">1" indicates cases where there are both first cost savings and annual utility bill savings.

Table 17: Comparison of Multifamily On-Bill Cost Effectiveness Results with Additional PV (Per Dwelling Unit)

		Neutral Cost				Min. Cost Effectiveness			
CZ	Utility	PV Capacity (kW)	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio	PV Capacity (kW)	Utility Bill Savings	Equipment Cost Savings	On-Bill B/C Ratio
01	PG&E	2.7	-($1,057)	+$0	0	3.0	+$1,198	-($1,052)	1.1

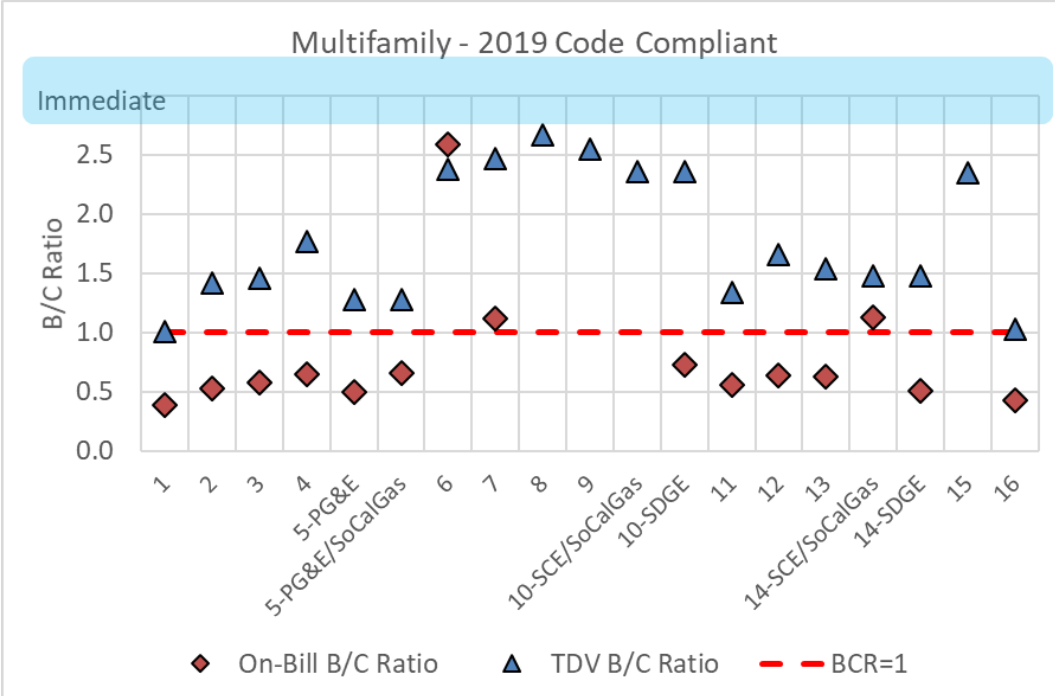

Figure 12: B/C ratio results for a multifamily all-electric code compliant home versus a mixed fuel code compliant home

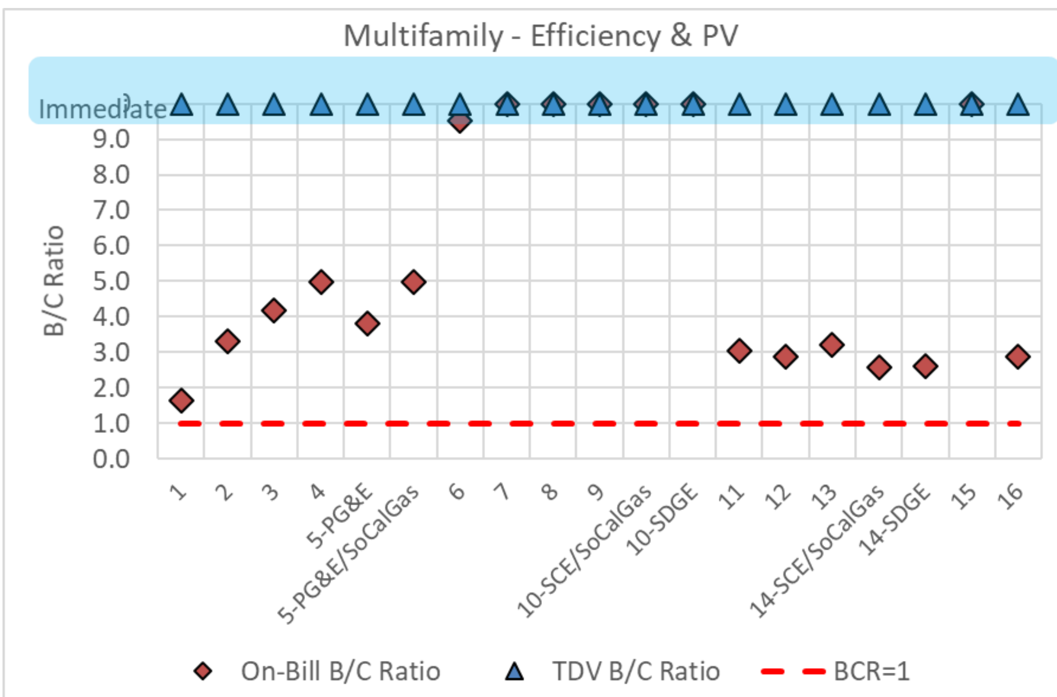

Figure 13: B/C ratio results for the multifamily Efficiency & PV all-electric home versus a mixed fuel code compliant home

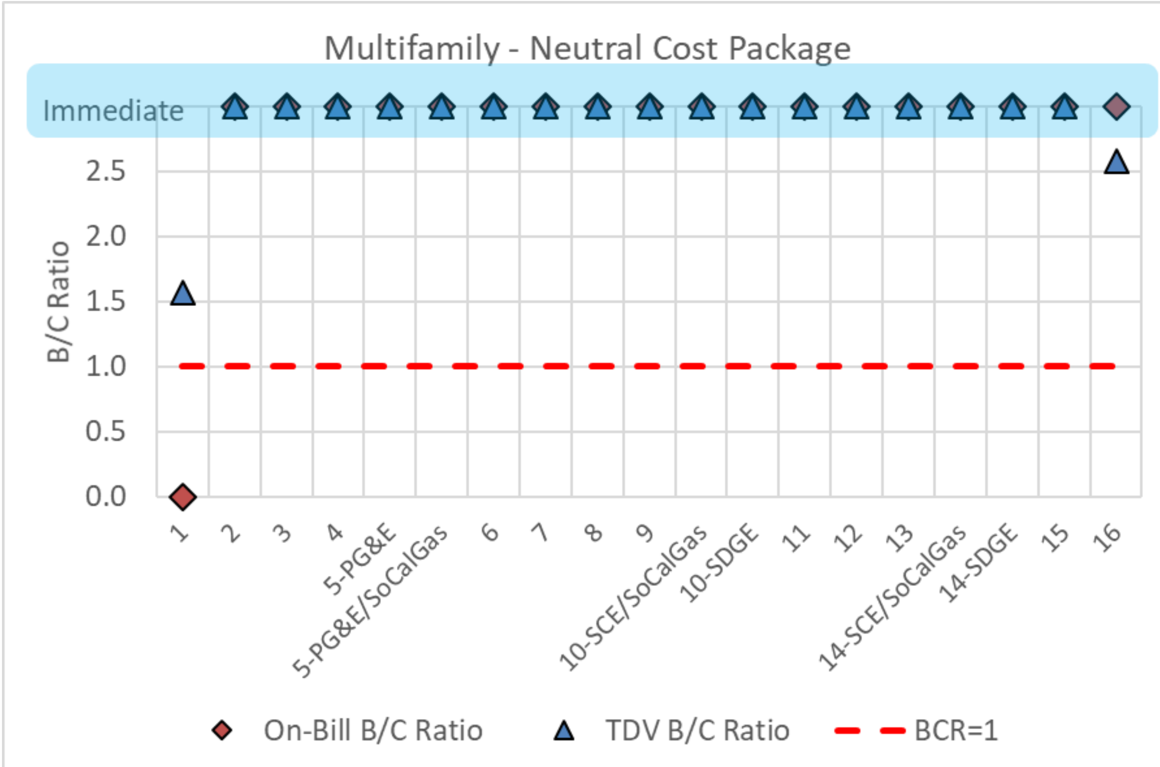

Figure 14: B/C ratio results for the multifamily neutral cost package all-electric home versus a mixed fuel code compliant home

4 Conclusions & Summary

This report evaluated the feasibility and cost-effectiveness of "above code" performance specifications through the application of efficiency measures, PV, and electric battery storage in all 16 California climate zones. The analysis found cost-effective packages across the state for both single family and low-rise multifamily buildings. For the building types and climate zones where cost-effective packages were identified, the results of this analysis can be used by local jurisdictions to support the adoption of reach codes. Cost-effectiveness was evaluated according to two metrics: On-Bill customer lifecycle benefit-to-cost and TDV lifecycle benefit-to-cost. While all the above code targets presented are based on packages that are cost-effective under at least one of these metrics, they are not all cost-effective under both metrics. Generally, the test for being cost-effective under the TDV methodology is less challenging than under the On-Bill methodology. Therefore, all packages presented are cost-effective based on TDV, and may or may not be cost-effective based on the On-Bill method. It is up to each jurisdiction to determine what metric is most appropriate for their application. A summary of results by climate zone are presented in Appendix G – Results by Climate Zone.

Above code targets are presented as Target EDR Margin, which have been defined for each scenario where a cost-effective package was identified. Target EDR Margins represent the maximum "reach" values that meet the requirements. Jurisdictions may adopt less stringent requirements. For the Efficiency Package the Target EDR Margin was defined based on the lower EDR Margin of the Efficiency – Non-Preempted Package and the Efficiency – Equipment, Preempted Package. For example, if the cost-effective Non-Preempted package has an EDR Margin of 3 and the Preempted package an EDR Margin of 4, the Target EDR Margin is set at 3.

The average incremental cost for the single family Efficiency packages is ~$1,750. The Efficiency & PV Package average incremental cost is $9,180 and for the Efficiency & PV/Battery Package it is approximately $5,600 for the mixed fuel cases and $15,100 for the all-electric cases. The incremental costs for each multifamily apartment are approximately 30-40% lower. See Table 8 and Table 11 for a summary of package costs by case.

Table 18 and Table 19 summarize the maximum Target EDR Margins determined to be cost effective for each package for single family and multifamily, respectively. Cases labeled as “n/a” in the tables indicate where no cost-effective package was identified under either On-Bill or TDV methodology.

This analysis also looked at the GHG emissions impacts of the various packages. An all-electric design reduces GHG emissions 40-50% in most cases relative to a comparable mixed fuel design.

There is significant interest throughout California on electrification of new buildings. The Reach Code Team assembled data on the cost differences between a code compliant mixed fuel building and a code compliant all-electric building. Based on lifetime equipment cost savings (the difference in first cost for equipment and infrastructure combined with incremental replacement costs) of $5,349 for an all-electric single family home this analysis found that from a customer on-bill perspective, the all-electric code compliant option is cost-effective in Climates Zones 6 through 9, 10 (SCE/SoCalGas territory only), and 15, and cost-effective in all climate zones except 1 and 16 based on TDV. For multifamily buildings, based on a cost savings of $2,337 per apartment, the code compliant option is cost-effective in Climates Zones 6 through 9, 10 & 14 (SCE/SoCalGas territory only), and 15, and cost-effective based on TDV.

Adding efficiency and PV to the code compliant all-electric buildings increases the cost-effectiveness in all climate zones. The Efficiency & PV Package is cost-effective when compared to a mixed fuel code compliant building in all climate zones for both single family and multifamily buildings based on both the On-Bill and TDV methodologies. The Efficiency & PV package adds PV to offset 90% of the electricity use of the home. While this results in higher installed costs, the reduced lifetime utility costs are larger ($0 to $6,000 lifetime incremental equipment costs in many climates for single family homes and an associated $4,500 to $13,500 lifetime utility cost savings across the same cases), resulting in positive B/C ratios for all cases.

The Reach Code Team also evaluated a neutral cost electrification scenario where the cost savings for the all-electric code compliant home is invested in a larger PV system, resulting in a lifetime incremental cost of zero based on the On-Bill approach. This package results in utility cost savings and positive on-bill B/C ratio in all cases except Climate Zones 1 and 16 for single family, and Climate Zone 1 for low-rise multifamily. Increasing the PV sizes in those climates by approximately 30% resulted in positive on-bill B/C ratios, while still not resulting in oversizing of PV systems.

Other studies have shown that cost-effectiveness of electrification increases with high efficiency space conditioning and water heating equipment in the all-electric home. This was not directly evaluated in this analysis but based on the favorable cost-effectiveness results of the Equipment, Preempted package for the individual mixed fuel and all-electric upgrades it’s expected that applying similar packages to the electrification analysis would result in increased cost-effectiveness.

The Reach Code Team found there can be substantial variability in first costs, particularly related to natural gas infrastructure. Costs are project-dependent and will be impacted by such factors as site characteristics, distance to the nearest gas main, joint trenching, whether work is conducted by the utility or a private contractor, and number of homes per development among other things. While the best cost data available to the Reach Code Team was applied in this analysis, individual projects may experience different costs, either higher or lower than the estimates presented here.

Table 18: Summary of Single Family Target EDR Margins

Climate Zone	Mixed Fuel		All-Electric		
	Efficiency	Efficiency & PV/Battery	Efficiency	Efficiency & PV	Efficiency & PV/Battery
01	5.0	10.5	6.5	31.0	41.0
02	3.0	10.0	4.5	19.0	30.0
03	2.5	10.0	4.0	18.0	29.0
04	2.5	10.0	3.0	17.0	28.5
05	2.5	9.0	4.0	18.0	28.5
06	1.5	9.5	2.0	14.0	26.0
07	n/a	9.0	n/a	11.0	24.0
08	1.0	8.0	1.5	10.5	21.5
09	2.5	8.5	2.5	11.5	21.0
10	3.0	9.5	3.0	11.0	21.0
11	4.0	9.0	4.5	14.0	23.0
12	3.0	9.5	3.5	15.5	25.0
13	4.5	9.5	5.0	13.0	22.0
14	4.5	9.0	5.5	15.5	23.5
15	4.5	7.0	5.5	6.0	13.0
16	5.0	10.5	4.5	26.5	35.0

Table 19: Summary of Multifamily Target EDR Margins

Climate Zone	Mixed Fuel		All-Electric		
	Efficiency	Efficiency & PV/Battery	Efficiency	Efficiency & PV	Efficiency & PV/Battery
01	2.0	11.5	3.0	22.5	34.5
02	1.5	10.5	1.5	17.5	30.5
03	0.5	10.0	n/a	16.0	29.5
04	1.0	11.0	1.0	15.0	28.5
05	0.5	9.5	0.5	17.0	30.0
06	1.0	10.5	1.0	13.5	27.5
07	0.5	11.0	0.5	12.5	27.0
08	1.0	9.5	1.0	11.5	24.0
09	1.5	9.5	1.5	11.0	23.0
10	1.5	10.0	1.5	10.5	23.0
11	2.5	10.5	3.5	13.0	25.0
12	1.5	10.0	2.5	14.0	26.5
13	3.0	10.5	3.0	12.0	23.5
14	3.0	9.5	3.5	14.0	24.5
15	4.0	8.5	4.0	7.0	16.5
16	2.0	9.5	3.0	19.5	29.5

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Appendix A – California Climate Zone Map

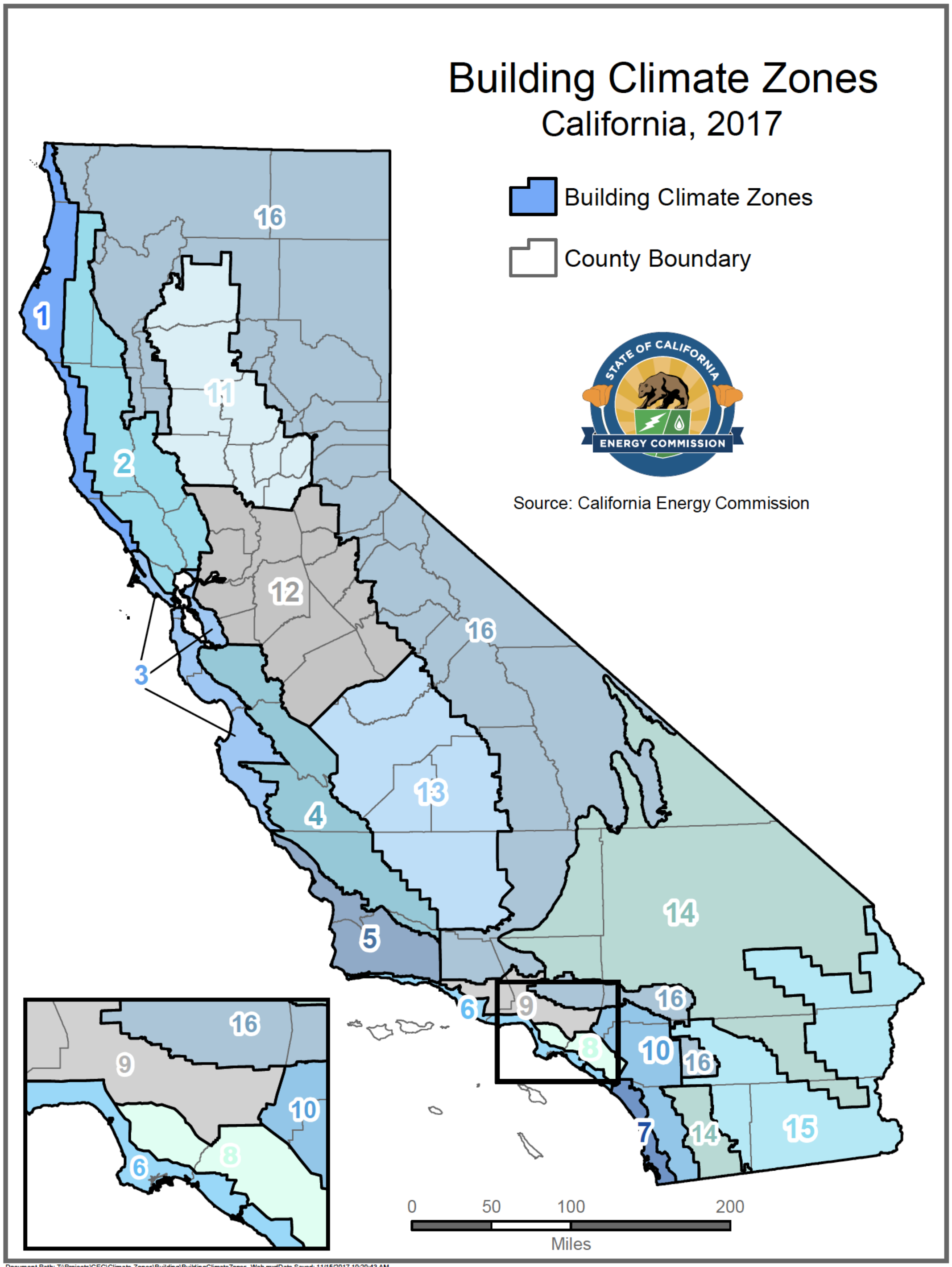

Figure 15: Map of California Climate Zones (courtesy of the California Energy Commission[17])

[17] https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html

Appendix B – Utility Tariff Details

PG&E

The following pages provide details on the PG&E electricity and natural gas tariffs applied in this study. Table 20 describes the baseline territories that were assumed for each climate zone.

Table 20: 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 January 2019 according to the rates shown below.

Pacific Gas and Electric Company

Residential Non-CARE and CARE Gas Tariff Rates
January 1, 2018, to Present
($/therm)[1/]

Effective Date	Advice Letter Number	Minimum Transportation Charge[2/] (per day)	Procurement Charge	Transportation Charge[2/]		TOTAL Residential Non-CARE Schedules Charge[3/] (Non-CARE)	
				Baseline	Excess	Baseline	Excess
01/01/18	3918-G	$0.09863	$0.37310	$0.91828	$1.46925	$1.29138	$1.84235
02/01/18	3931-G	$0.09863	$0.40635	$0.91828	$1.46925	$1.32463	$1.87560
03/01/18	3941-G	$0.09863	$0.32103	$0.91828	$1.46925	$1.23931	$1.79028
04/01/18	3959-G	$0.09863	$0.34783	$0.91828	$1.46925	$1.26611	$1.81708
05/01/18	3969-G	$0.09863	$0.26995	$0.91828	$1.46925	$1.18823	$1.73920
06/01/18	3980-G	$0.09863	$0.21571	$0.91828	$1.46925	$1.13399	$1.68496
07/01/18	3984-G	$0.09863	$0.22488	$0.93438	$1.49502	$1.15926	$1.71990
08/01/18	3995-G	$0.09863	$0.28814	$0.93438	$1.49502	$1.22252	$1.78316
09/01/18	4008-G	$0.09863	$0.25597	$0.93438	$1.49502	$1.19035	$1.75099
10/01/18	4018-G	$0.09863	$0.27383	$0.93438	$1.49502	$1.20821	$1.76885
11/01/18	4034-G	$0.09863	$0.35368	$0.93438	$1.49502	$1.28806	$1.84870
12/01/18	4046-G	$0.09863	$0.42932	$0.93438	$1.49502	$1.36370	$1.92434
01/01/19	4052-G	$0.09863	$0.43394[7/]	$0.99414	$1.59063	$1.42808	$2.02457

[1/] Unless otherwise noted
[2/] Effective July 1, 2005, the Transportation Charge will be no less than the Minimum Transportation Charge of $0.09863 (per day). Applicable to Rate Schedule G-1 only and does not apply to submetered tenants of master-metered customers served under gas Rate Schedule GS and GT.
[3/] Schedule G-PPPS (Public Purpose Program Surcharge) needs to be added to the TOTAL Non-CARE Charge and TOTAL CARE Charge for bill calculation. See Schedule G-PPPS for details and exempt customers.
[4/] CARE Schedules include California Solar Initiative (CSI) Exemption in accordance with Advice Letter 3257-G-A.
[5/] Per dwelling unit per day (Multifamily Service)
[6/] Per installed space per day (Mobilehome Park Service)
[7/] This procurement rate includes a charge of $0.03686 per therm to reflect account balance amortizations in accordance with Advice Letter 3157-G.
[8/] **Residential bill credit of ($29.85) per household, annual bill credit occurring in the October 2018 bill cycle, thereafter in the April bill cycle.**
Seasons: **Winter** = Nov-Mar **Summer** = April-Oct

Pacific Gas and Electric Company
U 39 San Francisco, California

	Revised	Cal. P.U.C. Sheet No.	43533-E
Cancelling	Revised	Cal. P.U.C. Sheet No.	42728-E

ELECTRIC SCHEDULE E-TOU
RESIDENTIAL TIME-OF-USE SERVICE

Sheet 4

RATES:
(Cont'd.)

OPTION B TOTAL RATES

Total Energy Rates ($ per kWh)	PEAK		OFF-PEAK	
Summer (all usage)	$0.37188	(R)	$0.26882	(R)
Winter (all usage)	$0.23441	(R)	$0.21561	(R)

Delivery Minimum Bill Amount ($ per meter per day) $0.32854

California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles) ($39.42)

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, DWR Bond, and New System Generation Charges based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.***

UNBUNDLING OF OPTION B TOTAL RATES

Generation	PEAK		OFF-PEAK	
Summer (all usage)	$0.21238		$0.10932	
Winter (all usage)	$0.10554		$0.08674	
Distribution**				
Summer (all usage)	$0.10716	(R)	$0.10716	(R)
Winter (all usage)	$0.07653	(R)	$0.07653	(R)

Transmission* (all usage)	$0.02469	(R)
Transmission Rate Adjustments* (all usage)	$0.00214	
Reliability Services* (all usage)	$0.00260	
Public Purpose Programs (all usage)	$0.01413	
Nuclear Decommissioning (all usage)	$0.00020	
Competition Transition Charges (all usage)	$0.00132	
Energy Cost Recovery Amount (all usage)	($0.00005)	
DWR Bond (all usage)	$0.00503	(R)
New System Generation Charge (all usage)**	$0.00228	

* Transmission, Transmission Rate Adjustments and Reliability Service charges are combined for presentation on customer bills.
** Distribution and New System Generation Charges are combined for presentation on customer bills.
*** This same assignment of revenues applies to direct access and community choice aggregation customers.

(Continued)

Advice	5444-E	*Issued by*	*Submitted*	December 18, 2018
Decision	18-08-013	***Robert S. Kenney***	*Effective*	January 1, 2019
		Vice President, Regulatory Affairs	*Resolution*	

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

	Revised	Cal. P.U.C. Sheet No.	34735-G
Cancelling	Revised	Cal. P.U.C. Sheet No.	34691-G

GAS SCHEDULE G-1 Sheet 1
RESIDENTIAL SERVICE

APPLICABILITY: This rate schedule[1] applies to natural gas service to Core End-Use Customers on PG&E's Transmission and/or Distribution Systems. To qualify, service must be to individually-metered single family premises for residential use, including those in a multifamily complex, and to separately-metered common areas in a multifamily complex where Schedules GM, GS, or GT are not applicable. Common area accounts that are separately metered by PG&E have an option of switching to a core commercial rate schedule. Common area accounts are those accounts that provide gas service to common use areas as defined in Rule 1.

Per D.15-10-032 and D.18-03-017, transportation rates include GHG Compliance Cost for non-covered entities. Customers who are directly billed by the Air Resources Board (ARB), i.e., covered entities, are exempt from paying AB 32 GHG Compliance Costs through PG&E's rates.[2] A "Cap-and-Trade Cost Exemption" credit for these costs will be shown as a line item on exempt customers' bills.[3, 4]

TERRITORY: Schedule G-1 applies everywhere within PG&E's natural gas Service Territory.

RATES: Customers on this schedule pay a Procurement Charge and a Transportation Charge, per meter, as shown below. The Transportation Charge will be no less than the Minimum Transportation Charge, as follows:

	Per Day			
Minimum Transportation Charge:[5]	$0.09863			

	Per Therm Baseline		Per Therm Excess	
Procurement:	$0.43394	(I)	$0.43394	(I)
Transportation Charge:	$0.99414	(I)	$1.59063	(I)
Total:	$1.42808	(I)	$2.02457	(I)
California Natural Gas Climate Credit (per Household, annual payment occurring in October 2018 bill cycle, and thereafter in the April bill cycle)	($25.45)	(I)		

Public Purpose Program Surcharge:

Customers served under this schedule are subject to a gas Public Purpose Program (PPP) Surcharge under Schedule G-PPPS.

See Preliminary Statement, Part B for the Default Tariff Rate Components.

The Procurement Charge on this schedule is equivalent to the rate shown on informational Schedule G-CP—Gas Procurement Service to Core End-Use Customers.

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1 PG&E's gas tariffs are available online at www.pge.com.
2 Covered entities are not exempt from paying costs associated with LUAF Gas and Gas used by Company Facilities.
3 The exemption credit will be equal to the effective non-exempt AB 32 GHG Compliance Cost Rate ($ per therm) included in Preliminary Statement – Part B, multiplied by the customer's billed volumes (therms) for each billing period.
4 PG&E will update its billing system annually to reflect newly exempt or newly excluded customers to conform with lists of Directly Billed Customers provided annually by the ARB.
5 The Minimum Transportation charge does not apply to submetered tenants of master-metered customers served under gas rate Schedules GS and GT.

(Continued)

Advice	4052-G	*Issued by*	*Submitted*	December 21, 2018
Decision	97-10-065 & 98-07-025	***Robert S. Kenney***	*Effective*	January 1, 2019
		Vice President, Regulatory Affairs	*Resolution*	

SCE

The following pages provide details on are the SCE electricity tariffs applied in this study. Table 21 describes the baseline territories that were assumed for each climate zone.

Table 21: SCE Baseline Territory by Climate Zone

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

	Delivery	Generation	Total Rate
TOU-Default-Rate-1 (On-Peak 4:00 pm - 9:00 pm)			
Energy Charge - $/kWh			
Summer Season - On-Peak	0.19880	0.20072	0.39952
Mid-Peak	0.19880	0.05948	0.25828
Off-Peak	0.15574	0.06023	0.21597
Winter Season - Mid-Peak	0.19880	0.08308	0.28188
Off-Peak	0.15574	0.11309	0.26883
Super-Off-Peak	0.15062	0.01344	0.16406
Basic Charge - $/day			
Single-Family Residence	0.031	0.000	0.031
Multi-Family Residence	0.024	0.000	0.024
Minimum Charge - $/day			
Single Family Residence	0.338	0.000	0.338
Multi-Family Residence	0.338	0.000	0.338
Baseline Credit - $/kWh	(0.06512)	0.00000	(0.06512)

	Delivery	Generation	Total Rate
TOU-D-Rate PRIME			
Energy Charge - $/kWh			
Summer Season - On-Peak	0.15926	0.19811	0.35737
Mid-Peak	0.15926	0.10092	0.26018
Off-Peak	0.08308	0.04687	0.12995
Winter Season - Mid-Peak	0.16268	0.16761	0.33029
Off-Peak	0.08081	0.04331	0.12412
Super-Off-Peak	0.08081	0.04331	0.12412
Customer Charge - $/day	0.395	0.000	0.395

TOU Period	Weekdays		Weekends and Holidays	
	Summer	Winter	Summer	Winter
On-Peak	4 p.m. - 9 p.m.			
Mid-Peak		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		8 a.m. - 4 p.m.		8 a.m. - 4 p.m.

PROPOSED
(7 Year Average 2010-2016)

Summer kWh per Day			Winter kWh per Day		
Baseline Region	Basic	All Electric	Baseline Region	Basic	All Electric
05	17.2	17.9	05	18.7	29.1
06	11.4	8.8	06	11.3	13.0
08	12.6	9.8	08	10.6	12.7
09	16.5	12.4	09	12.3	14.3
10	18.9	15.8	10	12.5	17.0
13	22.0	24.6	13	12.6	24.3
14	18.7	18.3	14	12.0	21.3
15	46.4	24.1	15	9.9	18.2
16	14.4	13.5	16	12.6	23.1

SoCalGas

Following are the SoCalGas natural gas tariffs applied in this study. Table 22 describes the baseline territories that were assumed for each climate zone.

Table 22: SoCalGas Baseline Territory by Climate Zone

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

SOUTHERN CALIFORNIA GAS COMPANY Revised CAL. P.U.C. SHEET NO. 55854-G
LOS ANGELES, CALIFORNIA CANCELING Revised CAL. P.U.C. SHEET NO. 55828-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¢	
Baseline Rate, per therm (baseline usage defined in Special Conditions 3 and 4):				
Procurement Charge: [2/]	41.589¢	42.676¢	N/A	R
Transmission Charge:	63.566¢	63.566¢	63.566¢	
Total Baseline Charge:	105.155¢	106.242¢	63.566¢	R
Non-Baseline Rate, per therm (usage in excess of baseline usage):				
Procurement Charge: [2/]	41.589¢	42.676¢	N/A	R
Transmission Charge:	96.806¢	96.806¢	96.806¢	
Total Non-Baseline Charge:	138.395¢	139.482¢	96.806¢	R

[1/] For the summer period beginning May 1 through October 31, with some exceptions, usage will be accumulated to at least 20 Ccf (100 cubic feet) before billing.

(Footnotes continue next page.)

(Continued)

(TO BE INSERTED BY UTILITY)	ISSUED BY	(TO BE INSERTED BY CAL. PUC)
ADVICE LETTER NO. 5410	Dan Skopec	SUBMITTED Jan 7, 2019
DECISION NO.	Vice President	EFFECTIVE Jan 10, 2019
1C6	Regulatory Affairs	RESOLUTION NO. G-3351

SDG&E

Following are the SDG&E electricity and natural gas tariffs applied in this study. Table 23 describes the baseline territories that were assumed for each climate zone.

Table 23: SDG&E Baseline Territory by Climate Zone

	Baseline Territory
CZ07	Coastal
CZ10	Inland
CZ14	Mountain

SDGE
San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 31320-E
Canceling Revised Cal. P.U.C. Sheet No. 31103-E

Sheet 2

SCHEDULE TOU-DR1

RESIDENTIAL TIME-OF-USE

RATES

Total Rates:

Description – TOU DR1	UDC Total Rate		DWR-BC Rate		EECC Rate + DWR Credit		Total Rate	
Summer:								
On-Peak	0.29562	R	0.00503	R	0.35013	R	0.65078	R
Off-Peak	0.29562	R	0.00503	R	0.11235	R	0.41300	R
Super Off-Peak	0.29562	R	0.00503	R	0.05739	R	0.35804	R
Winter:								
On-Peak	0.32037	R	0.00503	R	0.07618	R	0.40158	R
Off-Peak	0.32037	R	0.00503	R	0.06762	R	0.39302	R
Super Off-Peak	0.32037	R	0.00503	R	0.05812	R	0.38352	R
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.19921)	I					(0.19921)	I
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.16853)	I					(0.16853)	I
Minimum Bill ($/day)	0.329						0.329	

Description – TOU DR1	UDC Total Rate		DWR-BC Rate	EECC Rate + DWR Credit		Total Rate		Total Effective Care Rate	
Summer – CARE Rates:									
On-Peak	0.29494	R	0.00000	0.35013	R	0.64507	R	0.41628	R
Off-Peak	0.29494	R	0.00000	0.11235	R	0.40729	R	0.26077	R
Super Off-Peak	0.29494	R	0.00000	0.05739	R	0.35233	R	0.22483	R
Winter – CARE Rates:									
On-Peak	0.31969	R	0.00000	0.07618	R	0.39587	R	0.25330	R
Off-Peak	0.31969	R	0.00000	0.06762	R	0.38731	R	0.24770	R
Super Off-Peak	0.31969	R	0.00000	0.05812	R	0.37781	R	0.24149	R
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.19921)	I				(0.19921)	I	(0.13028)	I
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.16853)	I				(0.16853)	I	(0.11022)	I
Minimum Bill ($/day)	0.164					0.164		0.164	

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)

2C11

Advice Ltr. No. 3326-E

Decision No.

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Submitted Dec 28, 2018
Effective Jan 1, 2019
Resolution No.

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 23614-G
Canceling Revised Cal. P.U.C. Sheet No. 23601-G

Sheet 1

SCHEDULE GR

RESIDENTIAL NATURAL GAS SERVICE
(Includes Rates for GR, GR-C, GTC/GTCA)

APPLICABILITY

The GR rate is applicable to natural gas procurement service for 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 GTC/GTCA rate is applicable to intrastate gas transportation-only services to individually metered residential customers, as set forth in Special Condition 11.

Customers taking service under this schedule may be eligible for a 20% California Alternate Rate for Energy (CARE) program discount, reflected as a separate line item on the bill, if they qualify to receive service under the terms and conditions of Schedule G-CARE.

TERRITORY

Within the entire territory served natural gas by the utility.

RATES

	GR	GR-C		GTC/GTCA[1/]
Baseline Rate, per therm (baseline usage defined in Special Conditions 3 and 4):				
Procurement Charge:[2/]	$0.41614	$0.41614	R	N/A
Transmission Charge:	$1.01230	$1.01230		$1.01230
Total Baseline Charge:	$1.42844	$1.42844	R	$1.01230
Non-Baseline Rate, per therm (usage in excess of baseline usage):				
Procurement Charge:[2/]	$0.41614	$0.41614	R	N/A
Transmission Charge:	$1.19980	$1.19980		$1.19980
Total Non-Baseline Charge:	$1.61594	$1.61594	R	$1.19980
Minimum Bill, per day:[3/]				
Non-CARE customers:	$0.09863	$0.09863		$0.09863
CARE customers:	$0.07890	$0.07890		$0.07890

[1/] 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.
[2/] This charge is applicable to Utility Procurement Customers and includes the GPC and GPC-A Procurement Charges shown in Schedule GPC which are subject to change monthly as set forth in Special Condition 7.
[3/] Effective starting May 1, 2017, the minimum bill is calculated as the minimum bill charge of $0.09863 per day times the number of days in the billing cycle (approximately $3 per month) with a 20% discount applied for CARE customer resulting in a minimum bill charge of $0.07890 per day (approximately $2.40 per month).

(Continued)

1C5
Advice Ltr. No. 2735-G
Decision No.

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Submitted Jan 7, 2019
Effective Jan 10, 2019
Resolution No.

Escalation Assumptions

The average annual escalation rates in the following table were used in this study and are from E3's 2019 study Residential Building Electrification in California (Energy & Environmental Economics, 2019). These rates are applied to the 2019 rate schedules over a thirty-year period beginning in 2020. SDG&E was not covered in the E3 study. The Reach Code Team reviewed SDG&E's GRC filing and applied the same approach that E3 applied for PG&E and SoCalGas to arrive at average escalation rates between 2020 and 2022.

Table 24: Real Utility Rate Escalation Rate Assumptions

	Statewide Electric Residential Average Rate (%/year, real)	Natural Gas Residential Core Rate (%/yr escalation, real)		
		PG&E	SoCalGas	SDG&E
2020	2.0%	1.48%	6.37%	5.00%
2021	2.0%	5.69%	4.12%	3.14%
2022	2.0%	1.11%	4.12%	2.94%
2023	2.0%	4.0%	4.0%	4.0%
2024	2.0%	4.0%	4.0%	4.0%
2025	2.0%	4.0%	4.0%	4.0%
2026	1.0%	1.0%	1.0%	1.0%
2027	1.0%	1.0%	1.0%	1.0%
2028	1.0%	1.0%	1.0%	1.0%
2029	1.0%	1.0%	1.0%	1.0%
2030	1.0%	1.0%	1.0%	1.0%
2031	1.0%	1.0%	1.0%	1.0%
2032	1.0%	1.0%	1.0%	1.0%
2033	1.0%	1.0%	1.0%	1.0%
2034	1.0%	1.0%	1.0%	1.0%
2035	1.0%	1.0%	1.0%	1.0%
2036	1.0%	1.0%	1.0%	1.0%
2037	1.0%	1.0%	1.0%	1.0%
2038	1.0%	1.0%	1.0%	1.0%
2039	1.0%	1.0%	1.0%	1.0%
2040	1.0%	1.0%	1.0%	1.0%
2041	1.0%	1.0%	1.0%	1.0%
2042	1.0%	1.0%	1.0%	1.0%
2043	1.0%	1.0%	1.0%	1.0%
2044	1.0%	1.0%	1.0%	1.0%
2045	1.0%	1.0%	1.0%	1.0%
2046	1.0%	1.0%	1.0%	1.0%
2047	1.0%	1.0%	1.0%	1.0%
2048	1.0%	1.0%	1.0%	1.0%
2049	1.0%	1.0%	1.0%	1.0%

Appendix C – Single Family Detailed Results

Table 25: Single Family Mixed Fuel Efficiency Package Cost-Effectiveness Results

		BASECASE					Non-Preempted								Equipment - Preempted							
CZ	Utility	Total EDR	Efficiency EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW	On-Bill B/C Ratio	TDV B/C Ratio
1	PG&E	32.5	54.2	23	3.0	3.3	27.9	49.0	5.3	18.8%	2.5	3.2	3.4	2.8	26.0	47.3	6.9	25.1%	2.3	3.2	4.9	4.1
2	PG&E	25.0	46.0	12	2.2	2.8	22.0	42.7	3.3	16.3%	1.9	2.8	1.6	1.7	21.8	42.6	3.3	16.4%	1.9	2.8	3.8	3.6
3	PG&E	23.9	46.9	10	1.9	2.7	21.3	43.9	3.0	16.7%	1.6	2.7	1.3	1.3	20.1	42.8	4.1	22.8%	1.5	2.7	1.9	2.0
4	PG&E	23.1	44.9	8	1.9	2.7	20.8	42.4	2.5	13.9%	1.7	2.7	0.9	1.2	20.5	42.2	2.7	14.9%	1.6	2.7	2.4	2.7
5	PG&E	22.2	44.4	10	1.8	2.6	19.7	41.7	2.7	16.7%	1.6	2.5	1.1	1.2	19.7	41.7	2.6	16.2%	1.5	2.5	2.3	2.5
5	PG&E/SoCalGas	22.2	44.4	10	1.8	2.6	19.7	41.7	2.7	16.7%	1.6	2.5	0.9	1.2	19.7	41.7	2.6	16.2%	1.5	2.5	2.0	2.5
6	SCE/SoCalGas	23.3	49.9	10	1.6	2.7	21.5	47.8	2.0	12.1%	1.5	2.7	0.7	1.2	21.5	47.9	2.0	11.8%	1.4	2.7	1.6	2.0
7	SDG&E	20.3	49.1	5	1.3	2.6	20.3	49.1	0.0	0.0%	1.3	2.6	-	-	18.8	47.6	1.5	12.4%	1.2	2.6	1.5	1.4
8	SCE/SoCalGas	21.3	46.9	10	1.4	2.9	20.1	45.6	1.3	7.7%	1.3	2.9	0.6	1.4	19.7	45.3	1.6	9.4%	1.3	2.9	1.3	1.8
9	SCE/SoCalGas	24.5	47.7	13	1.5	2.9	22.3	45.1	2.6	11.7%	1.5	2.9	0.7	2.0	21.9	44.8	2.9	13.4%	1.4	2.9	1.8	3.7
10	SCE/SoCalGas	24.2	46.3	10	1.6	3.0	21.7	43.1	3.2	14.3%	1.5	3.0	0.6	1.3	21.5	43.1	3.2	14.6%	1.4	3.0	2.0	3.8
10	SDG&E	24.2	46.3	10	1.6	3.0	21.7	43.1	3.2	14.3%	1.5	3.0	0.8	1.3	21.5	43.1	3.2	14.6%	1.4	3.0	2.6	3.8
11	PG&E	24.6	44.9	11	2.1	3.6	21.3	40.6	4.3	16.4%	1.9	3.4	0.8	1.2	20.7	39.9	5.1	19.2%	1.8	3.4	2.5	3.7
12	PG&E	25.5	44.8	12	2.1	3.0	22.5	41.3	3.5	14.9%	1.9	2.9	1.2	1.8	22.5	41.4	3.4	14.4%	1.9	3.0	3.3	4.6
13	PG&E	25.7	46.5	11	2.0	3.8	22.2	41.9	4.6	16.9%	1.8	3.6	0.8	1.3	21.2	40.7	5.8	21.4%	1.7	3.6	5.3	8.4
14	SCE/SoCalGas	25.3	46.3	15	2.3	3.2	21.5	41.3	5.0	18.5%	2.1	3.0	1.6	2.5	20.8	40.4	5.8	21.7%	2.0	3.0	4.0	6.1
14	SDG&E	25.3	46.3	15	2.3	3.2	21.5	41.3	5.0	18.5%	2.1	3.0	1.9	2.5	20.8	40.4	5.8	21.7%	2.0	3.0	4.9	6.1
15	SCE/SoCalGas	22.4	49.1	11	1.7	5.4	19.7	44.3	4.8	14.8%	1.6	5.0	1.0	1.6	19.5	44.1	5.0	15.4%	1.5	5.0	>1	>1
16	PG&E	30.4	48.9	22	3.3	2.7	25.0	43.5	5.4	20.6%	2.6	2.7	1.6	1.5	24.8	42.7	6.2	23.5%	2.7	2.6	2.2	2.2

“>1” = indicates cases where there is both first cost savings and annual utility bill savings.

Table 26: Single Family Mixed Fuel Efficiency & PV/Battery Package Cost-Effectiveness Results

		BASECASE				Efficiency & PV/Battery						
CZ	Utility	Total EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW	Total EDR	Total EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW	On-Bill B/C Ratio	TDV B/C Ratio
1	PG&E	32.5	23	3.0	3.3	21.9	10.6	31.8%	2.4	3.3	0.9	1.6
2	PG&E	25.0	12	2.2	2.8	14.9	10.1	27.3%	1.8	2.9	0.5	1.6
3	PG&E	23.9	10	1.9	2.7	13.9	10.0	27.7%	1.5	2.8	0.4	1.4
4	PG&E	23.1	8	1.9	2.7	13.0	10.1	24.9%	1.5	2.8	0.3	1.5
5	PG&E	22.2	10	1.8	2.6	12.8	9.4	29.7%	1.4	2.6	0.4	1.3
5	PG&E/SoCalGas	22.2	10	1.8	2.6	12.8	9.4	29.7%	1.4	2.6	0.3	1.3
6	SCE/SoCalGas	23.3	10	1.6	2.7	13.6	9.8	20.1%	1.2	2.8	0.8	1.3
7	SDG&E	20.3	5	1.3	2.6	11.1	9.2	9.0%	1.0	2.7	0.1	1.3
8	SCE/SoCalGas	21.3	10	1.4	2.9	12.9	8.4	23.7%	1.1	3.0	0.9	1.3
9	SCE/SoCalGas	24.5	13	1.5	2.9	15.7	8.8	24.7%	1.2	3.0	1.0	1.5
10	SCE/SoCalGas	24.2	10	1.6	3.0	14.6	9.6	27.3%	1.3	3.1	1.0	1.5
10	SDG&E	24.2	10	1.6	3.0	14.6	9.6	27.3%	1.3	3.1	0.6	1.5
11	PG&E	24.6	11	2.1	3.6	15.4	9.2	29.4%	1.8	3.5	0.4	1.5
12	PG&E	25.5	12	2.1	3.0	15.9	9.6	28.9%	1.8	3.0	0.4	1.7
13	PG&E	25.7	11	2.0	3.8	16.1	9.7	28.9%	1.7	3.7	0.4	1.6
14	SCE/SoCalGas	25.3	15	2.3	3.2	16.3	9.0	30.1%	1.8	3.1	1.3	1.7
14	SDG&E	25.3	15	2.3	3.2	16.3	9.0	30.1%	1.8	3.1	1.2	1.7
15	SCE/SoCalGas	22.4	11	1.7	5.4	15.3	7.1	25.1%	1.4	5.1	1.1	1.5
16	PG&E	30.4	22	3.3	2.7	19.9	10.5	32.6%	2.4	2.8	0.9	1.4

">1" = indicates cases where there is both first cost savings and annual utility bill savings.

Table 27: Single Family All-Electric Efficiency Package Cost-Effectiveness Results

		BASECASE					Non-Preempted								Equipment - Preempted							
CZ	Utility	Total EDR	Efficiency EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW	On-Bill B/C Ratio	TDV B/C Ratio
1	PG&E	46.8	68.2	36	1.5	3.3	31.8	53.0	15.2	40.2%	1.0	3.3	1.8	1.7	39.9	61.3	6.9	18.3%	1.3	3.3	2.9	2.7
2	PG&E	32.8	53.7	16	1.1	2.8	27.9	48.7	4.9	20.5%	0.9	2.8	1.2	1.1	27.7	48.5	5.1	21.2%	0.9	2.8	2.3	2.1
3	PG&E	33.1	55.6	14	1.0	2.7	28.5	50.9	4.7	20.6%	0.8	2.7	2.6	2.4	28.7	51.2	4.4	19.6%	0.9	2.7	1.8	1.6
4	PG&E	31.3	52.8	12	1.0	2.7	27.9	49.4	3.4	15.5%	0.9	2.7	1.9	1.8	27.4	48.9	3.9	17.6%	0.9	2.7	1.5	1.5
5	PG&E	32.5	54.2	16	1.0	2.6	28.1	49.9	4.4	19.7%	0.9	2.6	2.6	2.3	28.0	49.8	4.4	20.3%	0.9	2.6	1.9	1.7
5	PG&E/SoCalGas	32.5	54.2	16	1.0	2.6	28.1	49.9	4.4	19.7%	0.9	2.6	2.6	2.3	28.0	49.8	4.4	20.3%	0.9	2.6	1.9	1.7
6	SCE/SoCalGas	29.7	55.8	12	0.9	2.7	27.7	53.8	2.0	10.9%	0.8	2.7	1.3	1.4	26.8	53.0	2.9	16.0%	0.8	2.7	2.2	2.3
7	SDG&E	27.1	55.3	7	0.7	2.6	27.1	55.3	0.0	0.0%	0.7	2.6	-	-	24.8	53.0	2.2	16.9%	0.7	2.6	1.6	1.7
8	SCE/SoCalGas	26.1	51.5	10	0.8	2.9	24.5	49.9	1.6	8.9%	0.8	2.9	0.6	1.2	24.4	49.7	1.8	9.7%	0.8	2.9	2.8	3.0
9	SCE/SoCalGas	28.8	51.9	13	0.9	2.9	26.0	49.1	2.8	12.5%	0.8	2.9	0.8	2.0	25.5	48.6	3.3	14.7%	0.8	2.9	2.1	3.2
10	SCE/SoCalGas	28.8	50.7	11	0.9	3.0	25.7	47.6	3.1	14.0%	0.9	3.0	0.9	1.5	25.3	47.2	3.4	15.5%	0.8	3.0	2.3	3.2
10	SDG&E	28.8	50.7	11	0.9	3.0	25.7	47.6	3.1	14.0%	0.9	3.0	1.1	1.5	25.3	47.2	3.4	15.5%	0.8	3.0	2.6	3.2
11	PG&E	30.0	50.2	12	1.1	3.6	25.4	45.6	4.6	16.2%	1.0	3.6	1.2	1.5	24.1	44.3	5.9	20.8%	0.9	3.6	3.0	3.3
12	PG&E	30.9	50.1	13	1.0	3.0	27.1	46.3	3.8	15.3%	0.9	3.0	0.8	1.1	25.8	45.0	5.1	20.4%	0.9	3.0	2.0	2.5
13	PG&E	30.7	51.5	13	1.1	3.8	25.7	46.4	5.1	17.4%	0.9	3.8	1.1	1.4	24.7	45.4	6.0	20.9%	0.9	3.8	2.9	3.3
14	SCE/SoCalGas	31.3	52.2	16	1.4	3.2	25.7	46.6	5.6	18.9%	1.2	3.2	1.0	1.5	25.3	46.2	6.0	20.5%	1.2	3.2	2.3	3.1
14	SDG&E	31.3	52.2	16	1.4	3.2	25.7	46.6	5.6	18.9%	1.2	3.2	1.3	1.5	25.3	46.2	6.0	20.5%	1.2	3.2	2.9	3.1
15	SCE/SoCalGas	26.2	52.8	8	1.3	5.4	20.6	47.2	5.6	16.8%	1.1	5.4	1.1	1.6	18.9	45.5	7.3	21.8%	1.0	5.4	3.3	4.5
16	PG&E	46.5	64.6	39	1.7	2.7	36.8	54.9	9.7	25.2%	1.4	2.7	1.7	1.7	41.6	59.7	4.9	12.7%	1.6	2.7	2.4	2.3

Table 28: Single Family All-Electric Efficiency & PV-PV/Battery Package Cost-Effectiveness Results

		BASECASE				Efficiency & PV							Efficiency & PV/Battery						
CZ	Utility	Total EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW	Total EDR	Total EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR	Total EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW	On-Bill B/C Ratio	TDV B/C Ratio
1	PG&E	46.8	36	1.5	3.3	15.4	31.4	40.2%	0.5	6.0	1.8	1.5	5.6	41.2	51.9%	0.3	6.76	1.4	1.4
2	PG&E	32.8	16	1.1	2.8	13.4	19.4	20.5%	0.5	4.9	1.8	1.4	2.7	30.1	31.5%	0.3	5.51	1.4	1.4
3	PG&E	33.1	14	1.0	2.7	14.6	18.5	20.6%	0.5	4.5	2.2	1.7	3.7	29.3	31.6%	0.2	5.10	1.5	1.6
4	PG&E	31.3	12	1.0	2.7	14.1	17.2	15.5%	0.5	4.5	2.1	1.6	2.8	28.6	26.5%	0.2	5.15	1.5	1.6
5	PG&E	32.5	16	1.0	2.6	14.3	18.2	19.7%	0.5	4.3	2.3	1.8	3.8	28.7	32.7%	0.2	4.84	1.6	1.6
5	PG&E/SoCalGas	32.5	16	1.0	2.6	14.3	18.2	19.7%	0.5	4.3	2.3	1.8	3.8	28.7	32.7%	0.2	4.84	1.6	1.6
6	SCE/SoCalGas	29.7	12	0.9	2.7	15.5	14.3	10.9%	0.6	4.1	1.2	1.5	3.6	26.1	18.9%	0.3	4.68	1.2	1.4
7	SDG&E	27.1	7	0.7	2.6	15.8	11.3	0.7%	0.6	3.7	1.9	1.5	2.9	24.2	6.7%	0.3	4.21	1.3	1.5
8	SCE/SoCalGas	26.1	10	0.8	2.9	15.1	10.9	8.9%	0.6	4.0	1.0	1.5	4.5	21.6	24.9%	0.3	4.54	1.1	1.4
9	SCE/SoCalGas	28.8	13	0.9	2.9	17.3	11.5	12.5%	0.7	4.1	1.1	1.6	7.6	21.3	25.5%	0.4	4.66	1.1	1.5
10	SCE/SoCalGas	28.8	11	0.9	3.0	17.7	11.1	14.0%	0.7	4.2	1.1	1.5	7.6	21.2	27.0%	0.4	4.78	1.1	1.5
10	SDG&E	28.8	11	0.9	3.0	17.7	11.1	14.0%	0.7	4.2	1.7	1.5	7.6	21.2	27.0%	0.4	4.78	1.4	1.5
11	PG&E	30.0	12	1.1	3.6	15.8	14.2	16.2%	0.6	5.4	1.8	1.6	6.8	23.2	29.2%	0.4	6.11	1.5	1.6
12	PG&E	30.9	13	1.0	3.0	15.2	15.7	15.3%	0.5	5.0	1.7	1.4	5.6	25.4	29.3%	0.3	5.62	1.3	1.5
13	PG&E	30.7	13	1.1	3.8	17.3	13.4	17.4%	0.6	5.4	1.7	1.5	8.2	22.5	29.4%	0.4	6.14	1.4	1.5
14	SCE/SoCalGas	31.3	16	1.4	3.2	15.8	15.5	18.9%	0.9	4.8	1.2	1.6	7.4	23.9	30.9%	0.6	5.39	1.4	1.6
14	SDG&E	31.3	16	1.4	3.2	15.8	15.5	18.9%	0.9	4.8	1.8	1.6	7.4	23.9	30.9%	0.6	5.39	1.7	1.6
15	SCE/SoCalGas	26.2	8	1.3	5.4	20.0	6.2	16.8%	1.1	5.5	1.1	1.6	12.7	13.5	27.0%	0.8	6.25	1.2	1.5
16	PG&E	46.5	39	1.7	2.7	19.6	27.0	25.2%	0.9	5.5	2.1	1.6	11.1	35.4	34.3%	0.6	6.17	1.7	1.5

“>1” = indicates cases where there is both first cost savings and annual utility bill savings.

Appendix D – Single Family Measure Summary

Table 29: Single Family Mixed Fuel Efficiency – Non-Preempted Package Measure Summary

CZ	Duct	Infiltratio	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
2	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
3	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
4	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
6	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	1.0 PV scaling
8	< 12 ft ducts in attic	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
9	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
11	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
12	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
13	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
14	VLLDCS	3 ACH50	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
15	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling

VVLDCS – Verified Low Leakage Ducts in Conditioned Space

Table 30: Single Family Mixed Fuel Efficiency – Equipment, Preempted Package Measure Summary

CZ	Duct	Infiltratio	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	96 AFUE, 0.35W/cfm	1.0 PV scaling
2	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	96 AFUE, 0.35W/cfm	1.0 PV scaling
3	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	96 AFUE, 0.35W/cfm	1.0 PV scaling
4	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	96 AFUE, 0.35W/cfm	1.0 PV scaling
5	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	96 AFUE, 0.35W/cfm	1.0 PV scaling
6	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	92 AFUE, 0.35W/cfm	1.0 PV scaling
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	92 AFUE, 0.35W/cfm	1.0 PV scaling
8	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	92 AFUE, 0.35W/cfm	1.0 PV scaling
9	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
10	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
11	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	18 SEER, 96 AFUE, 0.35W/cfm	1.0 PV scaling
12	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
13	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
14	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
15	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	18 SEER, 96 AFUE, 0.35W/cfm	1.0 PV scaling

LLAHU - Low Leakage Air Handling Unit
VVLDCS – Verified Low Leakage Ducts in Conditioned Space

Table 31: Single Family Mixed Fuel Efficiency & PV/Battery Package Measure Summary

CZ	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
2	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
3	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
4	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
6	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Basic CHW credit (0.7)	Code Min	1.0 PV scaling + 5kWh batt
8	< 12 ft ducts in attic	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
9	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
11	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
12	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
13	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
14	VLLDCS	3 ACH50	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
15	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt

VVLDCS – Verified Low Leakage Ducts in Conditioned Space

Table 32: Single Family All-Electric Efficiency – Non-Preempted Package Measure Summary

CZ	Duct	Infiltratio	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
2	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
3	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
4	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
6	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	Std Design PV
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Std Design PV
8	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	Std Design PV
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	Std Design PV
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
11	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
12	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
13	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
14	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
15	VLLDCS	Code Min	0.043 wall (	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
16	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	Code Min	Code Min	0.45 W/cfm	Std Design PV

VVLDCS – Verified Low Leakage Ducts in Conditioned Space

Table 33: Single Family All-Electric Efficiency – Equipment, Preempted Package Measure Summary

CZ	Duct	Infiltratio	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
2	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
3	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
4	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
5	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
6	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
8	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	0.45 W/cfm	Std Design PV
9	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
10	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
11	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
12	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
13	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
14	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
15	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
16	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV

LLAHU - Low Leakage Air Handling Unit
VVLDCS – Verified Low Leakage Ducts in Conditioned Space

Table 34: Single Family All-Electric Efficiency & PV Package Measure Summary

CZ	Duct	Infiltratio	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
2	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
3	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
4	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
6	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
8	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
11	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
12	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
13	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
14	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
15	VLLDCS	Code Min	0.043 wall	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
16	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling

VVLDCS – Verified Low Leakage Ducts in Conditioned Space

Table 35: Single Family All-Electric Efficiency & PV/Battery Package Measure Summary

CZ	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
2	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
3	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
4	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
6	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
8	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
11	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
12	VLLDCS	Code Min	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
13	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
14	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
15	VLLDCS	Code Min	0.043 wall (SF); 0.048 wall (MF)	R-38 + R-30 attic	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt
16	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt

VVLDCS – Verified Low Leakage Ducts in Conditioned Space

Appendix E – Multifamily Detailed Results

Table 36: Multifamily Mixed Fuel Efficiency Package Cost-Effectiveness Results

Climate Zone	Utility	BASECASE					Non-Preempted								Equipment - Preempted							
		Total EDR	Efficiency EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW per Building	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW per Building	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW per Building	On-Bill B/C Ratio	TDV B/C Ratio
01	PG&E	28.6	60.7	23	2.7	15.9	25.1	57.3	3.4	19.3%	2.3	16.0	1.1	1.2	26.4	58.4	2.3	12.2%	2.5	15.9	1.3	1.4
02	PG&E	25.7	56.5	12	2.4	13.9	24.2	54.7	1.8	9.9%	2.3	13.8	1.0	1.7	23.6	54.2	2.3	12.5%	2.2	13.9	1.1	1.5
03	PG&E	24.7	57.8	10	2.1	13.5	24.0	57.2	0.6	4.7%	2.1	13.5	1.0	1.1	23.1	56.2	1.6	11.2%	1.9	13.4	1.1	1.2
04	PG&E	25.5	56.8	8	2.2	13.6	24.3	55.5	1.3	7.7%	2.1	13.5	0.8	1.2	23.8	54.9	1.9	10.9%	2.0	13.5	1.1	1.7
05	PG&E	24.2	57.4	10	2.1	12.6	23.7	56.9	0.5	4.4%	2.0	12.6	1.0	1.0	22.7	55.9	1.5	10.9%	1.9	12.6	1.2	1.3
05	PG&E/SoCalGas	24.2	57.4	10	2.1	12.6	23.7	56.9	0.5	4.4%	2.0	12.6	0.8	1.0	22.7	55.9	1.5	10.9%	1.9	12.6	1.1	1.3
06	SCE/SoCalGas	26.8	63.2	10	2.2	13.9	25.8	61.9	1.3	7.0%	2.1	13.8	0.6	1.5	25.5	61.9	1.3	7.4%	2.0	13.9	1.4	1.7
07	SDG&E	26.8	64.5	5	2.1	13.2	26.1	63.6	0.9	5.3%	2.1	13.1	0.7	2.2	25.0	62.5	2.0	12.2%	2.0	13.2	1.1	1.4
08	SCE/SoCalGas	25.7	61.8	10	2.2	14.6	24.6	60.3	1.5	7.4%	2.1	14.5	0.7	1.4	24.6	60.7	1.1	5.7%	2.0	14.6	1.4	1.7
09	SCE/SoCalGas	26.4	59.7	13	2.2	14.7	25.0	57.9	1.8	8.2%	2.2	14.4	1.5	3.3	24.1	56.9	2.8	12.9%	2.1	14.4	1.7	2.9
10	SCE/SoCalGas	27.0	58.7	10	2.3	15.1	25.7	57.0	1.7	7.7%	2.2	14.9	0.8	1.7	24.7	55.8	2.9	13.0%	2.1	14.8	2.0	3.3
10	SDG&E	27.0	58.7	10	2.3	15.1	25.7	57.0	1.7	7.7%	2.2	14.9	1.1	1.7	24.7	55.8	2.9	13.0%	2.1	14.8	2.6	3.3
11	PG&E	24.5	54.5	11	2.4	16.6	22.3	51.6	2.9	11.9%	2.2	16.3	0.7	1.2	22.2	51.3	3.2	13.2%	2.2	16.1	1.8	3.3
12	PG&E	25.9	55.3	12	2.3	14.9	24.3	53.4	1.9	8.8%	2.2	14.8	1.1	2.2	23.5	52.5	2.8	12.8%	2.1	14.7	1.2	2.2
13	PG&E	26.1	55.9	11	2.3	17.5	23.7	52.8	3.1	12.1%	2.1	17.1	0.6	1.3	23.7	52.5	3.4	13.2%	2.1	16.9	2.0	3.8
14	SCE/SoCalGas	25.6	55.9	15	2.8	14.6	23.1	52.8	3.1	12.8%	2.5	14.3	0.7	1.2	23.2	52.6	3.3	13.3%	2.5	14.2	2.0	3.0
14	SDG&E	25.6	55.9	15	2.8	14.6	23.1	52.8	3.1	12.8%	2.5	14.3	0.9	1.2	23.2	52.6	3.3	13.3%	2.5	14.2	2.5	3.0
15	SCE/SoCalGas	25.0	59.2	11	2.5	21.6	22.7	55.0	4.2	12.9%	2.4	20.4	1.4	2.3	22.6	54.8	4.4	13.5%	2.3	20.4	>1	>1
16	PG&E	29.4	57.3	22	3.5	13.4	26.6	54.9	2.4	11.3%	3.0	13.7	1.1	1.2	26.9	54.4	2.9	13.1%	3.1	13.2	1.8	2.1

“>1” = indicates cases where there is both first cost savings and annual utility bill savings.

Table 37: Multifamily Mixed Fuel Efficiency & PV/Battery Package Cost-Effectiveness Results

		BASECASE				Efficiency & PV/Battery						
CZ	Utility	Total EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW per Building	Total EDR	Total EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW per Building	On-Bill B/C Ratio	TDV B/C Ratio
01	PG&E	28.6	23	2.7	15.9	17.1	11.5	29.3%	2.1	16.5	0.4	1.2
02	PG&E	25.7	12	2.4	13.9	14.8	10.9	16.9%	2.1	14.2	0.2	1.6
03	PG&E	24.7	10	2.1	13.5	14.4	10.3	10.7%	1.9	13.9	0.1	1.4
04	PG&E	25.5	8	2.2	13.6	14.3	11.2	15.7%	1.9	13.9	0.2	1.6
05	PG&E	24.2	10	2.1	12.6	14.3	9.9	9.4%	1.8	13.1	0.2	1.4
05	PG&E/SoCalGas	24.2	10	2.1	12.6	14.3	9.9	9.4%	1.8	13.1	0.1	1.4
06	SCE/SoCalGas	26.8	10	2.2	13.9	16.1	10.7	10.0%	1.8	14.2	0.6	1.4
07	SDG&E	26.8	5	2.1	13.2	15.8	11.0	7.3%	1.7	13.6	0.0	1.4
08	SCE/SoCalGas	25.7	10	2.2	14.6	15.8	9.9	13.4%	1.8	14.9	0.7	1.3
09	SCE/SoCalGas	26.4	13	2.2	14.7	16.7	9.7	15.2%	1.8	14.9	0.9	1.5
10	SCE/SoCalGas	27.0	10	2.3	15.1	16.6	10.4	13.7%	1.9	15.3	1.0	1.6
10	SDG&E	27.0	10	2.3	15.1	16.6	10.4	13.7%	1.9	15.3	0.2	1.6
11	PG&E	24.5	11	2.4	16.6	14.0	10.5	19.9%	2.0	16.7	0.4	1.6
12	PG&E	25.9	12	2.3	14.9	15.6	10.3	17.8%	2.0	15.2	0.3	1.7
13	PG&E	26.1	11	2.3	17.5	15.4	10.7	20.1%	2.0	17.5	0.4	1.6
14	SCE/SoCalGas	25.6	15	2.8	14.6	16.0	9.6	20.8%	2.2	14.7	1.1	1.4
14	SDG&E	25.6	15	2.8	14.6	16.0	9.6	20.8%	2.2	14.7	0.5	1.4
15	SCE/SoCalGas	25.0	11	2.5	21.6	16.2	8.8	18.9%	2.1	20.9	1.3	1.7
16	PG&E	29.4	22	3.5	13.4	19.5	9.9	19.3%	2.7	14.1	0.5	1.3

"inf" = indicates cases where there is both first cost savings and annual utility bill savings.

Table 38: Multifamily All-Electric Efficiency Package Cost-Effectiveness Results

		BASECASE					Non-Preempted								Equipment - Preempted							
CZ	Utility	Total EDR	Efficiency EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW per Building	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW per Building	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR	Efficiency EDR	Efficiency EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW per Building	On-Bill B/C Ratio	TDV B/C Ratio
01	PG&E	41.1	70.6	36	1.6	15.9	37.5	67.0	3.6	14.6%	1.5	15.9	1.6	1.4	37.1	67.3	3.3	18.4%	1.4	15.9	2.4	2.3
02	PG&E	34.3	63.4	16	1.4	13.9	32.4	61.5	1.9	9.1%	1.3	13.9	1.7	2.1	31.1	60.2	3.2	15.1%	1.3	13.9	1.6	1.6
03	PG&E	33.5	64.2	14	1.3	13.5	33.5	64.2	0.0	0.0%	1.3	13.5	-	-	30.4	61.5	2.7	19.5%	1.1	13.5	1.7	1.6
04	PG&E	32.0	61.4	12	1.3	13.6	30.5	60.0	1.4	8.0%	1.2	13.6	1.4	1.5	29.7	59.2	2.2	12.2%	1.2	13.6	1.2	1.1
05	PG&E	34.7	65.4	16	1.3	12.6	34.1	64.8	0.6	3.4%	1.3	12.6	1.1	0.9	30.6	61.8	3.6	23.5%	1.2	12.6	2.1	2.0
05	PG&E/SoCalGas	34.7	65.4	16	1.3	12.6	34.1	64.8	0.6	3.4%	1.3	12.6	1.1	0.9	30.6	61.8	3.6	23.5%	1.2	12.6	2.1	2.0
06	SCE/SoCalGas	31.9	65.9	12	1.3	13.9	30.9	64.9	1.0	5.9%	1.3	13.9	0.7	1.3	29.8	63.7	2.2	13.0%	1.2	13.9	1.6	1.9
07	SDG&E	31.7	66.6	7	1.2	13.2	31.1	66.0	0.6	4.6%	1.2	13.2	0.6	1.0	29.7	64.7	1.9	13.6%	1.1	13.2	1.6	1.7
08	SCE/SoCalGas	29.8	63.6	10	1.3	14.6	28.6	62.4	1.2	6.5%	1.2	14.6	0.9	1.7	27.9	61.7	1.9	10.3%	1.2	14.6	1.6	1.8
09	SCE/SoCalGas	30.4	61.9	13	1.3	14.7	28.7	60.3	1.6	8.1%	1.3	14.7	1.3	2.7	28.8	60.4	1.5	7.4%	1.2	14.7	1.6	1.6
10	SCE/SoCalGas	31.2	61.3	11	1.4	15.1	29.3	59.5	1.8	8.7%	1.3	15.1	1.2	2.0	29.3	59.5	1.8	8.6%	1.3	15.1	1.7	2.0
10	SDG&E	31.2	61.3	11	1.4	15.1	29.3	59.5	1.8	8.7%	1.3	15.1	1.5	2.0	29.3	59.5	1.8	8.6%	1.3	15.1	2.0	2.0
11	PG&E	31.9	60.6	12	1.4	16.6	28.5	57.1	3.5	13.1%	1.3	16.6	1.4	1.6	28.1	56.7	3.9	14.4%	1.3	16.6	2.0	2.3
12	PG&E	32.0	59.9	13	1.3	14.9	29.4	57.3	2.6	11.4%	1.2	14.9	0.9	1.1	29.0	57.0	2.9	13.0%	1.2	14.9	1.6	1.6
13	PG&E	32.1	60.5	13	1.4	17.5	28.8	57.2	3.3	12.6%	1.2	17.5	1.3	1.6	28.3	56.7	3.8	14.3%	1.2	17.5	2.0	2.3
14	SCE/SoCalGas	32.5	61.6	16	1.7	14.6	28.9	57.9	3.7	13.8%	1.6	14.6	1.2	1.6	28.7	57.8	3.8	14.3%	1.6	14.6	1.6	2.2
14	SDG&E	32.5	61.6	16	1.7	14.6	28.9	57.9	3.7	13.8%	1.6	14.6	1.5	1.6	28.7	57.8	3.8	14.3%	1.6	14.6	2.0	2.2
15	SCE/SoCalGas	28.2	61.0	8	1.8	21.6	23.9	56.6	4.4	14.2%	1.6	21.6	1.5	2.3	21.9	54.6	6.4	20.6%	1.5	21.6	1.2	1.7
16	PG&E	40.2	66.6	39	1.9	13.4	36.2	62.5	4.1	15.0%	1.7	13.4	2.1	2.1	37.1	63.4	3.2	11.4%	1.7	13.4	1.6	1.7

“>1” = indicates cases where there is both first cost savings and annual utility bill savings.

Table 39: Multifamily All-Electric Efficiency & PV-PV/Battery Package Cost-Effectiveness Results

Climate Zone	Utility	BASECASE				Efficiency & PV							Efficiency & PV/Battery						
		Total EDR	CALGreen Tier 1 EDR Target	lbs CO2 per sqft	PV kW per Building	Total EDR	Total EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW per Building	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR	Total EDR Margin	% Comp Margin	lbs CO2 per sqft	PV kW per Building	On-Bill B/C Ratio	TDV B/C Ratio
01	PG&E	41.1	36	1.6	15.9	18.6	22.5	14.6%	0.8	26.9	2.0	1.5	6.6	34.5	24.6%	0.4	30.3	1.3	1.4
02	PG&E	34.3	16	1.4	13.9	16.8	17.5	9.1%	0.7	21.9	2.4	1.8	3.4	30.9	16.1%	0.3	24.8	1.4	1.7
03	PG&E	33.5	14	1.3	13.5	17.4	16.1	2.6%	0.7	20.8	2.4	1.7	4.0	29.5	8.6%	0.3	23.6	1.3	1.6
04	PG&E	32.0	12	1.3	13.6	17.0	15.0	8.0%	0.7	20.2	2.4	1.8	3.1	28.9	16.0%	0.3	22.9	1.30	1.77
05	PG&E	34.7	16	1.3	12.6	17.6	17.1	3.4%	0.7	19.9	2.5	1.8	4.4	30.3	8.4%	0.3	22.5	1.4	1.7
05	PG&E/SoCalGas	34.7	16	1.3	12.6	17.6	17.1	3.4%	0.7	19.9	2.5	1.8	4.4	30.3	8.4%	0.3	22.5	1.4	1.7
06	SCE/SoCalGas	31.9	12	1.3	13.9	18.1	13.8	5.9%	1.0	19.5	1.2	1.7	4.4	27.5	8.9%	0.5	22.1	1.2	1.6
07	SDG&E	31.7	7	1.2	13.2	18.9	12.8	4.6%	0.9	18.1	2.1	1.8	4.6	27.1	6.6%	0.5	20.5	1.2	1.6
08	SCE/SoCalGas	29.8	10	1.3	14.6	18.2	11.6	6.5%	1.0	19.4	1.3	1.8	5.6	24.2	12.5%	0.5	22.0	1.2	1.6
09	SCE/SoCalGas	30.4	13	1.3	14.7	19.1	11.3	8.1%	1.0	19.4	1.3	1.9	7.1	23.3	15.1%	0.6	22.0	1.3	1.7
10	SCE/SoCalGas	31.2	11	1.4	15.1	20.4	10.8	8.7%	1.1	19.9	1.3	1.8	7.9	23.3	14.7%	0.6	22.5	1.3	1.7
10	SDG&E	31.2	11	1.4	15.1	20.4	10.8	8.7%	1.1	19.9	2.1	1.8	7.9	23.3	14.7%	0.6	22.5	1.4	1.7
11	PG&E	31.9	12	1.4	16.6	18.5	13.4	13.1%	0.8	22.8	2.2	1.8	6.6	25.3	21.1%	0.4	25.8	1.4	1.8
12	PG&E	32.0	13	1.3	14.9	17.6	14.4	11.4%	0.7	21.7	2.1	1.6	5.4	26.6	20.4%	0.4	24.5	1.3	1.7
13	PG&E	32.1	13	1.4	17.5	19.9	12.2	12.6%	0.8	23.3	2.1	1.7	8.2	23.9	20.6%	0.4	26.4	1.4	1.7
14	SCE/SoCalGas	32.5	16	1.7	14.6	18.5	14.0	13.8%	1.3	20.2	1.4	1.9	7.7	24.8	21.8%	0.8	22.8	1.4	1.8
14	SDG&E	32.5	16	1.7	14.6	18.5	14.0	13.8%	1.3	20.2	2.2	1.9	7.7	24.8	21.8%	0.8	22.8	1.7	1.8
15	SCE/SoCalGas	28.2	8	1.8	21.6	21.1	7.1	14.2%	1.5	23.6	1.4	2.1	11.3	16.9	20.2%	1.1	26.6	1.3	1.8
16	PG&E	40.2	39	1.9	13.4	20.6	19.6	15.0%	1.2	22.0	2.6	1.9	10.3	29.9	23.0%	0.8	24.8	1.6	1.7

“>1” = indicates cases where there is both first cost savings and annual utility bill savings.

Appendix F – Multifamily Measure Summary

Table 40: Multifamily Mixed Fuel Efficiency – Non-Preempted Package Measure Summary

CZ	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
2	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
3	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
4	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
5	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
6	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
7	Code Min	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
8	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Enh CHW credit (0.6)	0.35 W/cfm	1.0 PV scaling
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
11	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
12	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
13	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
14	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
15	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling

VLLDCS – Verified Low-Leakage Ducts in Conditioned Space

Table 41: Multifamily Mixed Fuel Efficiency – Equipment, Preempted Package Measure Summary

CZ	Duct	Infiltratio	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
2	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
3	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	92 AFUE, 0.35W/cfm	1.0 PV scaling
4	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 0.35 W/cfm	1.0 PV scaling
5	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	92 AFUE, 0.45W/cfm	1.0 PV scaling
6	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	Code Min	1.0 PV scaling
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 0.35 W/cfm	1.0 PV scaling
8	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	Code Min	1.0 PV scaling
9	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 0.35 W/cfm	1.0 PV scaling
10	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 0.35 W/cfm	1.0 PV scaling
11	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
12	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
13	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
14	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling
15	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 0.35 W/cfm	1.0 PV scaling
16	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	16 SEER, 92 AFUE, 0.35W/cfm	1.0 PV scaling

VLLDCS – Verified Low-Leakage Ducts in Conditioned Space

Table 42: Multifamily Mixed Fuel Efficiency & PV/Battery Package Measure Summary

CZ	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
2	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
3	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
4	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
5	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
6	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
7	Code Min	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
8	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Enh CHW credit (0.6)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
11	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
12	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
13	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
14	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
15	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 22kWh batt

VLLDCS – Verified Low-Leakage Ducts in Conditioned Space

Table 43: Multifamily All-Electric Efficiency – Non-Preempted Package Measure Summary

CZ	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
2	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
3	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Std Design PV
4	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	Code Min	Std Design PV
6	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	Std Design PV
7	Code Min	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	Std Design PV
8	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	Std Design PV
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	Std Design PV
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
11	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
12	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
13	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
14	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
15	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	Std Design PV

VLLDCS – Verified Low-Leakage Ducts in Conditioned Space

Table 44: Multifamily All-Electric Efficiency – Equipment, Preempted Package Measure Summary

CZ	Duct	Infiltratio	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
2	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
3	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
4	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
5	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
6	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	0.45 W/cfm	Std Design PV
7	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	0.45 W/cfm	Std Design PV
8	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	0.45 W/cfm	Std Design PV
9	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	0.45 W/cfm	Std Design PV
10	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	0.45 W/cfm	Std Design PV
11	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
12	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
13	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
14	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV
15	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
16	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	16 SEER, 9 HSPF, 0.45W/cfm	Std Design PV

VLLDCS – Verified Low-Leakage Ducts in Conditioned Space

Table 45: Multifamily All-Electric Efficiency & PV Package Measure Summary

CZ	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
2	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
3	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
4	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	Code Min	0.9 PV scaling
6	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
7	Code Min	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
8	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
11	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
12	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
13	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
14	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
15	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	0.9 PV scaling

VLLDCS – Verified Low-Leakage Ducts in Conditioned Space

Table 46: Multifamily All-Electric Efficiency & PV/Battery Package Measure Summary

CZ	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
1	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
2	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
3	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
4	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
5	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	R-10 slab insulation	Code Min	Code Min	1.0 PV scaling + 22kWh batt
6	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
7	Code Min	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
8	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
9	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
10	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	Code Min	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
11	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
12	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
13	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
14	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
15	VLLDCS	Code Min	Code Min	Code Min	0.25 solar reflectance	0.24/0.23 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt
16	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	R-10 slab insulation	Code Min	0.45 W/cfm	1.0 PV scaling + 22kWh batt

VLLDCS – Verified Low-Leakage Ducts in Conditioned Space

Appendix G – Results by Climate Zone

Climate Zone 1

Table 47: Single Family Climate Zone 1 Results Summary

Climate Zone 1 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	581	n/a	n/a	3.00	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	480	5.0	(0.08)	2.51	0.49	$1,355	3.38	2.82
	Efficiency-Equipment	0	440	6.5	(0.07)	2.32	0.68	$1,280	4.92	4.10
	Efficiency & PV/Battery	(28)	480	10.5	0.04	2.40	0.60	$5,311	0.87	1.61
All-Electric[2]	Code Compliant	7,079	0	n/a	n/a	1.51	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	4,461	0	15.0	0.00	1.01	0.50	$7,642	1.79	1.66
	Efficiency-Equipment	5,933	0	6.5	0.00	1.29	0.22	$2,108	2.94	2.74
	Efficiency & PV	889	0	31.0	2.67	0.52	1.00	$18,192	1.81	1.45
	Efficiency & PV/Battery	(14)	0	41.0	3.45	0.28	1.23	$24,770	1.45	1.40
Mixed Fuel to All-Electric[3]	Code Compliant	7,079	0	0.0	0.00	1.51	1.49	($5,349)	0.37	0.91
	Efficiency & PV	889	0	31.0	2.67	0.52	2.48	$12,844	1.43	2.11
	Neutral Cost	5,270	0	8.0	1.35	1.26	1.74	$0	0.00	1.09
	Min Cost Effectiveness	3,106	0	18.0	2.97	0.95	2.04	($6,372)	1.08	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, Neutral Cost, and Min Cost Effectiveness packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 48: Multifamily Climate Zone 1 Results Summary (Per Dwelling Unit)

Climate Zone 1 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	180	n/a	n/a	2.75	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	147	3.0	0.00	2.31	0.44	$960	1.10	1.18
	Efficiency-Equipment	(0)	159	2.0	(0.01)	2.48	0.27	$507	1.29	1.41
	Efficiency & PV/Battery	(14)	147	11.5	0.07	2.13	0.61	$3,094	0.35	1.21
All-Electric[2]	Code Compliant	2,624	0	n/a	n/a	1.62	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,328	0	3.5	0.00	1.46	0.15	$949	1.55	1.40
	Efficiency-Equipment	2,278	0	3.0	0.00	1.41	0.20	$795	2.39	2.26
	Efficiency & PV	499	0	22.5	1.37	0.75	0.86	$5,538	2.04	1.50
	Efficiency & PV/Battery	(7)	0	34.5	1.80	0.38	1.24	$8,919	1.33	1.43
Mixed Fuel to All-Electric[3]	Code Compliant	2,624	0	0.0	0.00	1.62	1.13	($2,337)	0.38	1.01
	Efficiency & PV	62	0	22.5	1.37	0.75	2.00	$3,202	1.63	>1
	Neutral Cost	1,693	0	9.5	0.70	1.25	1.50	$0	0.00	1.57
	Min Cost Effectiveness	1,273	0	14.0	1.01	1.09	1.66	($1,052)	1.14	3.76

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, Neutral Cost, and Min Cost Effectiveness packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 2

Table 49: Single Family Climate Zone 2 Results Summary

Climate Zone 2 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	421	n/a	n/a	2.23	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	360	3.0	(0.04)	1.94	0.30	$1,504	1.63	1.66
	Efficiency-Equipment	(0)	352	3.0	(0.03)	1.90	0.33	$724	3.77	3.63
	Efficiency & PV/Battery	(22)	360	10.0	0.06	1.82	0.41	$5,393	0.47	1.56
All-Electric[2]	Code Compliant	5,014	0	n/a	n/a	1.11	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	4,079	0	4.5	0.00	0.94	0.18	$3,943	1.21	1.07
	Efficiency-Equipment	4,122	0	5.0	0.00	0.94	0.17	$2,108	2.25	2.10
	Efficiency & PV	847	0	19.0	2.07	0.49	0.63	$12,106	1.83	1.38
	Efficiency & PV/Battery	(15)	0	30.0	2.71	0.26	0.86	$18,132	1.37	1.43
Mixed Fuel to All-Electric[3]	Code Compliant	5,014	0	0.0	0.00	1.11	1.12	($5,349)	0.52	1.59
	Efficiency & PV	847	0	19.0	2.07	0.49	1.75	$6,758	1.76	39.70
	Neutral Cost	2,891	0	9.5	1.36	0.82	1.41	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 50: Multifamily Climate Zone 2 Results Summary (Per Dwelling Unit)

Climate Zone 2 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	150	n/a	n/a	2.37	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	142	1.5	(0.02)	2.25	0.12	$309	0.97	1.75
	Efficiency-Equipment	(0)	134	2.0	(0.01)	2.15	0.22	$497	1.08	1.49
	Efficiency & PV/Battery	(11)	142	10.5	0.04	2.07	0.30	$2,413	0.17	1.60
All-Electric[2]	Code Compliant	2,151	0	n/a	n/a	1.38	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,038	0	1.5	0.00	1.32	0.06	$361	1.73	2.05
	Efficiency-Equipment	1,928	0	3.0	0.00	1.25	0.13	$795	1.56	1.56
	Efficiency & PV	476	0	17.5	1.00	0.72	0.67	$3,711	2.42	1.82
	Efficiency & PV/Battery	(7)	0	30.5	1.36	0.35	1.04	$6,833	1.38	1.74
Mixed Fuel to All-Electric[3]	Code Compliant	2,151	0	0.0	0.00	1.38	0.99	($2,337)	0.53	1.42
	Efficiency & PV	60	0	17.5	1.00	0.72	1.65	$1,375	3.31	>1
	Neutral Cost	1,063	0	10.5	0.70	0.96	1.41	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 3

Table 51: Single Family Climate Zone 3 Results Summary

Climate Zone 3 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	348	n/a	n/a	1.88	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	296	2.5	(0.03)	1.63	0.26	$1,552	1.28	1.31
	Efficiency-Equipment	(0)	273	4.0	(0.03)	1.52	0.37	$1,448	1.91	1.97
	Efficiency & PV/Battery	(20)	296	10.0	0.07	1.50	0.38	$5,438	0.38	1.38
All-Electric[2]	Code Compliant	4,355	0	n/a	n/a	1.00	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,584	0	4.5	0.00	0.85	0.15	$1,519	2.60	2.36
	Efficiency-Equipment	3,670	0	4.0	0.00	0.86	0.14	$2,108	1.76	1.62
	Efficiency & PV	790	0	18.0	1.77	0.46	0.54	$8,517	2.22	1.68
	Efficiency & PV/Battery	(12)	0	29.0	2.37	0.23	0.76	$14,380	1.50	1.58
Mixed Fuel to All-Electric[3]	Code Compliant	4,355	0	0.0	0.00	1.00	0.89	($5,349)	0.55	1.53
	Efficiency & PV	790	0	18.0	1.77	0.46	1.43	$3,169	2.88	>1
	Neutral Cost	2,217	0	10.5	1.35	0.70	1.18	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 52: Multifamily Climate Zone 3 Results Summary (Per Dwelling Unit)

Climate Zone 3 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	133	n/a	n/a	2.13	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	127	0.5	(0.00)	2.06	0.07	$175	1.00	1.11
	Efficiency-Equipment	(0)	119	1.5	(0.00)	1.94	0.19	$403	1.11	1.23
	Efficiency & PV/Battery	(10)	127	10.0	0.05	1.86	0.27	$2,279	0.11	1.41
All-Electric[2]	Code Compliant	1,944	0	n/a	n/a	1.27	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,944	0	0.0	0.00	1.27	0.00	$0	-	-
	Efficiency-Equipment	1,698	0	2.5	0.00	1.13	0.14	$795	1.73	1.58
	Efficiency & PV	457	0	16.0	0.92	0.69	0.58	$3,272	2.43	1.73
	Efficiency & PV/Battery	(7)	0	29.5	1.26	0.33	0.94	$6,344	1.32	1.64
Mixed Fuel to All-Electric[3]	Code Compliant	1,944	0	0.0	0.00	1.27	0.86	($2,337)	0.58	1.46
	Efficiency & PV	57	0	16.0	0.92	0.69	1.43	$936	4.18	>1
	Neutral Cost	845	0	11.5	0.70	0.85	1.28	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 4

Table 53: Single Family Climate Zone 4 Results Summary

Climate Zone 4 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	347	n/a	n/a	1.88	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	306	2.5	(0.03)	1.68	0.20	$1,556	0.93	1.15
	Efficiency-Equipment	(0)	294	2.5	(0.02)	1.62	0.26	$758	2.39	2.67
	Efficiency & PV/Battery	(18)	306	10.0	0.07	1.55	0.33	$5,434	0.30	1.48
All-Electric[2]	Code Compliant	4,342	0	n/a	n/a	1.00	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,775	0	3.0	0.00	0.89	0.11	$1,519	1.92	1.84
	Efficiency-Equipment	3,747	0	3.5	0.00	0.88	0.12	$2,108	1.52	1.52
	Efficiency & PV	814	0	17.0	1.84	0.48	0.52	$8,786	2.13	1.62
	Efficiency & PV/Battery	(11)	0	28.5	2.44	0.25	0.75	$14,664	1.46	1.61
Mixed Fuel to All-Electric[3]	Code Compliant	4,342	0	0.0	0.00	1.00	0.88	($5,349)	0.55	1.59
	Efficiency & PV	814	0	17.0	1.84	0.48	1.40	$3,438	2.64	>1
	Neutral Cost	2,166	0	10.0	1.35	0.70	1.18	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 54: Multifamily Climate Zone 4 Results Summary (Per Dwelling Unit)

Climate Zone 4 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	134	n/a	n/a	2.16	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	127	1.0	(0.01)	2.06	0.10	$329	0.75	1.24
	Efficiency-Equipment	(0)	123	1.5	(0.01)	2.01	0.15	$351	1.06	1.74
	Efficiency & PV/Battery	(9)	127	11.0	0.04	1.87	0.29	$2,429	0.17	1.60
All-Electric[2]	Code Compliant	1,887	0	n/a	n/a	1.25	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,794	0	1.0	0.00	1.21	0.05	$361	1.38	1.54
	Efficiency-Equipment	1,712	0	2.0	0.00	1.15	0.10	$795	1.23	1.09
	Efficiency & PV	453	0	15.0	0.83	0.69	0.57	$3,158	2.43	1.81
	Efficiency & PV/Battery	(7)	0	28.5	1.17	0.32	0.93	$6,201	1.30	1.77
Mixed Fuel to All-Electric[3]	Code Compliant	1,887	0	0.0	0.00	1.25	0.90	($2,337)	0.65	1.77
	Efficiency & PV	57	0	15.0	0.83	0.69	1.47	$822	4.96	>1
	Neutral Cost	767	0	11.0	0.70	0.82	1.33	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design..

Climate Zone 5 PG&E

Table 55: Single Family Climate Zone 5 PG&E Results Summary

Climate Zone 5 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	331	n/a	n/a	1.79	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	281	2.5	(0.03)	1.55	0.24	$1,571	1.10	1.22
	Efficiency-Equipment	(0)	279	2.5	(0.02)	1.54	0.25	$772	2.29	2.48
	Efficiency & PV/Battery	(14)	281	9.0	0.07	1.43	0.36	$5,433	0.37	1.32
All-Electric[2]	Code Compliant	4,452	0	n/a	n/a	1.01	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,687	0	4.0	0.00	0.86	0.15	$1,519	2.58	2.31
	Efficiency-Equipment	3,737	0	4.0	0.00	0.87	0.14	$2,108	1.85	1.70
	Efficiency & PV	798	0	18.0	1.72	0.46	0.55	$8,307	2.31	1.76
	Efficiency & PV/Battery	(8)	0	28.5	2.29	0.24	0.78	$14,047	1.59	1.63
Mixed Fuel to All-Electric[3]	Code Compliant	4,452	0	0.0	0.00	1.01	0.78	($5,349)	0.48	1.32
	Efficiency & PV	798	0	18.0	1.72	0.46	1.33	$2,959	2.72	>1
	Neutral Cost	2,172	0	11.0	1.35	0.70	1.10	$0	>1	40.07

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 56: Multifamily Climate Zone 5 PG&E Results Summary (Per Dwelling Unit)

Climate Zone 5 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	131	n/a	n/a	2.10	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	126	0.5	(0.00)	2.03	0.07	$180	0.99	1.03
	Efficiency-Equipment	(0)	117	1.5	(0.00)	1.92	0.19	$358	1.24	1.34
	Efficiency & PV/Battery	(7)	126	9.5	0.05	1.84	0.26	$2,273	0.15	1.38
All-Electric[2]	Code Compliant	2,044	0	n/a	n/a	1.32	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,990	0	0.5	0.00	1.30	0.03	$247	1.09	0.86
	Efficiency-Equipment	1,738	0	3.5	0.00	1.15	0.17	$795	2.15	2.03
	Efficiency & PV	465	0	17.0	0.91	0.70	0.62	$3,293	2.53	1.82
	Efficiency & PV/Battery	(6)	0	30.0	1.24	0.34	0.98	$6,314	1.44	1.69
Mixed Fuel to All-Electric[3]	Code Compliant	2,044	0	0.0	0.00	1.32	0.78	($2,337)	0.50	1.28
	Efficiency & PV	58	0	17.0	0.91	0.70	1.40	$956	3.80	>1
	Neutral Cost	874	0	12.5	0.70	0.87	1.23	$0	>1	23.44

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 5 PG&E/SoCalGas

Table 57: Single Family Climate Zone 5 PG&E/SoCalGas Results Summary

Climate Zone 5 PG&E/SoCalGas Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	331	n/a	n/a	1.79	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	281	2.5	(0.03)	1.55	0.24	$1,571	0.92	1.22
	Efficiency-Equipment	(0)	279	2.5	(0.02)	1.54	0.25	$772	1.98	2.48
	Efficiency & PV/Battery	(14)	281	9.0	0.07	1.43	0.36	$5,433	0.31	1.32
All-Electric[2]	Code Compliant	4,452	0	n/a	n/a	1.01	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,687	0	4.0	0.00	0.86	0.15	$1,519	2.58	2.31
	Efficiency-Equipment	3,737	0	4.0	0.00	0.87	0.14	$2,108	1.85	1.70
	Efficiency & PV	798	0	18.0	1.72	0.46	0.55	$8,307	2.31	1.76
	Efficiency & PV/Battery	(8)	0	28.5	2.29	0.24	0.78	$14,047	1.59	1.63
Mixed Fuel to All-Electric[3]	Code Compliant	4,452	0	0.0	0.00	1.01	0.78	($5,349)	0.48	1.32
	Efficiency & PV	798	0	18.0	1.72	0.46	1.33	$2,959	2.75	>1
	Neutral Cost	2,172	0	11.0	1.35	0.70	1.10	$0	>1	40.07

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 58: Multifamily Climate Zone 5 PG&E/SoCalGas Results Summary (Per Dwelling Unit)

Climate Zone 5 PG&E/SoCalGas Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel [1]	Code Compliant	0	131	n/a	n/a	2.10	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	126	0.5	(0.00)	2.03	0.07	$180	0.85	1.03
	Efficiency-Equipment	(0)	117	1.5	(0.00)	1.92	0.19	$358	1.09	1.34
	Efficiency & PV/Battery	(7)	126	9.5	0.05	1.84	0.26	$2,273	0.14	1.38
All-Electric [2]	Code Compliant	2,044	0	n/a	n/a	1.32	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,990	0	0.5	0.00	1.30	0.03	$247	1.09	0.86
	Efficiency-Equipment	1,738	0	3.5	0.00	1.15	0.17	$795	2.15	2.03
	Efficiency & PV	465	0	17.0	0.91	0.70	0.62	$3,293	2.53	1.82
	Efficiency & PV/Battery	(6)	0	30.0	1.24	0.34	0.98	$6,314	1.44	1.69
Mixed Fuel to All-Electric [3]	Code Compliant	2,044	0	0.0	0.00	1.32	0.78	($2,337)	0.65	1.28
	Efficiency & PV	58	0	17.0	0.91	0.70	1.40	$956	4.98	>1
	Neutral Cost	874	0	12.5	0.70	0.87	1.23	$0	>1	23.44

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 6

Table 59: Single Family Climate Zone 6 Results Summary

Climate Zone 6 SCE/SoCalGas Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf) Total	CO2-Equivalent Emissions (lbs/sf) Reduction	NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C) On-Bill	Benefit to Cost Ratio (B/C) TDV
Mixed Fuel[1]	Code Compliant	(0)	249	n/a	n/a	1.57	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	229	2.0	(0.02)	1.47	0.10	$1,003	0.66	1.15
	Efficiency-Equipment	(0)	218	1.5	(0.01)	1.41	0.15	$581	1.58	2.04
	Efficiency & PV/Battery	(13)	229	9.5	0.08	1.22	0.34	$4,889	0.84	1.27
All-Electric[2]	Code Compliant	3,099	0	n/a	n/a	0.87	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,885	0	2.0	0.00	0.83	0.05	$926	1.31	1.41
	Efficiency-Equipment	2,746	0	2.5	0.00	0.80	0.08	$846	2.20	2.29
	Efficiency & PV	722	0	14.0	1.37	0.63	0.24	$6,341	1.19	1.48
	Efficiency & PV/Battery	(6)	0	26.0	1.93	0.33	0.55	$12,036	1.15	1.43
Mixed Fuel to All-Electric[3]	Code Compliant	3,099	0	0.0	0.00	0.87	0.69	($5,349)	1.19	2.46
	Efficiency & PV	722	0	14.0	1.37	0.63	0.93	$992	3.07	>1
	Neutral Cost	959	0	12.0	1.36	0.67	0.89	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 60: Multifamily Climate Zone 6 Results Summary (Per Dwelling Unit)

Climate Zone 6 SCE/SoCalGas Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	114	n/a	n/a	2.17	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	112	1.0	(0.01)	2.14	0.03	$190	0.65	1.49
	Efficiency-Equipment	(0)	103	1.0	(0.00)	2.03	0.15	$213	1.43	1.74
	Efficiency & PV/Battery	(6)	112	10.5	0.04	1.76	0.41	$2,294	0.56	1.35
All-Electric[2]	Code Compliant	1,558	0	n/a	n/a	1.28	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,531	0	1.0	0.00	1.26	0.02	$231	0.65	1.34
	Efficiency-Equipment	1,430	0	2.0	0.00	1.20	0.08	$361	1.62	1.91
	Efficiency & PV	427	0	13.5	0.70	0.97	0.31	$2,580	1.24	1.71
	Efficiency & PV/Battery	(5)	0	27.5	1.02	0.49	0.79	$5,590	1.22	1.58
Mixed Fuel to All-Electric[3]	Code Compliant	1,558	0	0.0	0.00	1.28	0.90	($2,337)	2.59	2.38
	Efficiency & PV	53	0	13.5	0.70	0.97	1.20	$243	9.50	>1
	Neutral Cost	459	0	12.5	0.70	0.99	1.18	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 7

Table 61: Single Family Climate Zone 7 Results Summary

Climate Zone 7 SDG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	196	n/a	n/a	1.30	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	196	0.0	0.00	1.30	0.00	$0	-	-
	Efficiency-Equipment	0	171	1.5	(0.00)	1.18	0.12	$606	1.50	1.40
	Efficiency & PV/Battery	(12)	189	9.0	0.10	1.04	0.26	$4,028	0.06	1.32
All-Electric[2]	Code Compliant	2,479	0	n/a	n/a	0.75	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,479	0	0.0	0.00	0.75	0.00	$0	-	-
	Efficiency-Equipment	2,222	0	2.0	0.00	0.69	0.06	$846	1.60	1.65
	Efficiency & PV	674	0	11.0	1.10	0.58	0.17	$4,436	1.87	1.55
	Efficiency & PV/Battery	(6)	0	24.0	1.61	0.29	0.46	$9,936	1.25	1.47
Mixed Fuel to All-Electric[3]	Code Compliant	2,479	0	0.0	0.00	0.75	0.55	($5,349)	1.04	2.54
	Efficiency & PV	674	0	11.0	1.10	0.58	0.72	($912)	>1	>1
	Neutral Cost	267	0	13.5	1.35	0.55	0.75	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 62: Multifamily Climate Zone 7 Results Summary (Per Dwelling Unit)

Climate Zone 7 SDG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	110	n/a	n/a	2.11	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	108	0.5	(0.01)	2.08	0.03	$90	0.73	2.24
	Efficiency-Equipment	(0)	99	2.0	(0.00)	1.96	0.15	$366	1.07	1.41
	Efficiency & PV/Battery	(6)	108	11.0	0.05	1.71	0.40	$2,188	0.03	1.40
All-Electric[2]	Code Compliant	1,434	0	n/a	n/a	1.21	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,416	0	0.5	0.00	1.20	0.01	$202	0.60	1.02
	Efficiency-Equipment	1,319	0	1.5	0.00	1.14	0.07	$361	1.59	1.71
	Efficiency & PV	412	0	12.5	0.61	0.94	0.27	$2,261	2.08	1.76
	Efficiency & PV/Battery	(5)	0	27.0	0.92	0.47	0.74	$5,203	1.19	1.62
Mixed Fuel to All-Electric[3]	Code Compliant	1,434	0	0.0	0.00	1.21	0.90	($2,337)	1.12	2.47
	Efficiency & PV	51	0	12.5	0.61	0.94	1.17	($75)	>1	>1
	Neutral Cost	294	0	13.5	0.70	0.91	1.20	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 8

Table 63: Single Family Climate Zone 8 Results Summary

Climate Zone 8 SCE/SoCalGas Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	206	n/a	n/a	1.38	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	198	1.0	(0.02)	1.34	0.05	$581	0.57	1.41
	Efficiency-Equipment	0	181	1.5	(0.01)	1.27	0.12	$586	1.30	1.82
	Efficiency & PV/Battery	(13)	198	8.0	0.08	1.11	0.27	$4,466	0.90	1.31
All-Electric[2]	Code Compliant	2,576	0	n/a	n/a	0.80	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,483	0	1.5	0.00	0.78	0.02	$926	0.57	1.22
	Efficiency-Equipment	2,352	0	1.5	0.00	0.75	0.05	$412	2.82	3.03
	Efficiency & PV	703	0	10.5	1.13	0.62	0.18	$5,373	1.00	1.48
	Efficiency & PV/Battery	(7)	0	21.5	1.67	0.32	0.48	$11,016	1.09	1.42
Mixed Fuel to All-Electric[3]	Code Compliant	2,576	0	0.0	0.00	0.80	0.58	($5,349)	1.83	2.99
	Efficiency & PV	703	0	10.5	1.13	0.62	0.77	$25	107.93	>1
	Neutral Cost	439	0	11.0	1.36	0.60	0.78	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 64: Multifamily Climate Zone 8 Results Summary (Per Dwelling Unit)

Climate Zone 8 SCE/SoCalGas Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	109	n/a	n/a	2.18	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	106	1.5	(0.02)	2.13	0.05	$250	0.70	1.36
	Efficiency-Equipment	(0)	99	1.0	(0.00)	2.04	0.14	$213	1.37	1.67
	Efficiency & PV/Battery	(6)	106	9.5	0.03	1.77	0.41	$2,353	0.74	1.32
All-Electric[2]	Code Compliant	1,409	0	n/a	n/a	1.26	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,373	0	1.0	0.00	1.24	0.02	$231	0.87	1.72
	Efficiency-Equipment	1,276	0	1.5	0.00	1.18	0.08	$361	1.63	1.75
	Efficiency & PV	426	0	11.5	0.60	0.99	0.27	$2,240	1.26	1.78
	Efficiency & PV/Battery	(5)	0	24.0	0.92	0.53	0.73	$5,249	1.24	1.59
Mixed Fuel to All-Electric[3]	Code Compliant	1,409	0	0.0	0.00	1.26	0.91	($2,337)	6.69	2.67
	Efficiency & PV	53	0	11.5	0.60	0.99	1.18	($96)	>1	>1
	Neutral Cost	309	0	12.0	0.70	0.98	1.20	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 9

Table 65: Single Family Climate Zone 9 Results Summary

Climate Zone 9 SCE/SoCalGas Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	229	n/a	n/a	1.53	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	216	2.5	(0.04)	1.46	0.07	$912	0.69	1.97
	Efficiency-Equipment	0	201	2.5	(0.04)	1.38	0.15	$574	1.80	3.66
	Efficiency & PV/Battery	(14)	216	8.5	0.05	1.23	0.30	$4,785	0.99	1.48
All-Electric[2]	Code Compliant	2,801	0	n/a	n/a	0.87	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,645	0	2.5	0.00	0.84	0.04	$1,180	0.78	1.96
	Efficiency-Equipment	2,460	0	3.0	0.00	0.80	0.07	$846	2.11	3.22
	Efficiency & PV	745	0	11.5	1.16	0.66	0.21	$5,778	1.08	1.64
	Efficiency & PV/Battery	(9)	0	21.0	1.72	0.37	0.50	$11,454	1.11	1.53
Mixed Fuel to All-Electric[3]	Code Compliant	2,801	0	0.0	0.00	0.87	0.66	($5,349)	1.67	2.90
	Efficiency & PV	745	0	11.5	1.16	0.66	0.87	$429	7.15	>1
	Neutral Cost	594	0	10.0	1.36	0.67	0.86	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 66: Multifamily Climate Zone 9 Results Summary (Per Dwelling Unit)

Climate Zone 9 SCE/SoCalGas Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	111	n/a	n/a	2.24	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	109	1.5	(0.03)	2.19	0.05	$136	1.46	3.35
	Efficiency-Equipment	(0)	101	2.5	(0.03)	2.08	0.16	$274	1.66	2.87
	Efficiency & PV/Battery	(7)	109	9.5	0.03	1.84	0.40	$2,234	0.90	1.49
All-Electric[2]	Code Compliant	1,468	0	n/a	n/a	1.33	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,414	0	1.5	0.00	1.30	0.03	$231	1.29	2.70
	Efficiency-Equipment	1,334	0	1.5	0.00	1.25	0.08	$361	1.63	1.58
	Efficiency & PV	441	0	11.0	0.60	1.04	0.29	$2,232	1.34	1.91
	Efficiency & PV/Battery	(7)	0	23.0	0.92	0.58	0.75	$5,236	1.28	1.67
Mixed Fuel to All-Electric[3]	Code Compliant	1,468	0	0.0	0.00	1.33	0.91	($2,337)	4.38	2.55
	Efficiency & PV	55	0	11.0	0.60	1.04	1.20	($104)	>1	>1
	Neutral Cost	331	0	11.0	0.70	1.03	1.21	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 10 SCE/SoCalGas

Table 67: Single Family Climate Zone 10 SCE/SoCalGas Results Summary

Climate Zone 10 SCE/SoCalGas Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	239	n/a	n/a	1.61	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	217	3.0	(0.07)	1.48	0.13	$1,648	0.63	1.33
	Efficiency-Equipment	(0)	209	3.0	(0.06)	1.45	0.16	$593	2.05	3.84
	Efficiency & PV/Battery	(12)	217	9.5	0.03	1.25	0.36	$5,522	1.00	1.48
All-Electric[2]	Code Compliant	2,981	0	n/a	n/a	0.94	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,673	0	3.0	0.00	0.88	0.07	$1,773	0.92	1.52
	Efficiency-Equipment	2,563	0	3.0	0.00	0.85	0.10	$949	2.27	3.19
	Efficiency & PV	762	0	11.0	1.17	0.70	0.24	$6,405	1.08	1.50
	Efficiency & PV/Battery	(6)	0	21.0	1.74	0.41	0.53	$12,129	1.11	1.51
Mixed Fuel to All-Electric[3]	Code Compliant	2,981	0	0.0	0.00	0.94	0.67	($5,349)	1.45	2.66
	Efficiency & PV	762	0	11.0	1.17	0.70	0.91	$1,057	3.04	>1
	Neutral Cost	770	0	9.0	1.36	0.74	0.87	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 68: Multifamily Climate Zone 10 SCE/SoCalGas Results Summary (Per Dwelling Unit)

Climate Zone 10 SCE/SoCalGas Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	112	n/a	n/a	2.29	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	108	1.5	(0.02)	2.23	0.06	$278	0.81	1.69
	Efficiency-Equipment	(0)	102	2.5	(0.04)	2.13	0.16	$250	1.96	3.27
	Efficiency & PV/Battery	(6)	108	10.0	0.03	1.88	0.41	$2,376	0.98	1.57
All-Electric[2]	Code Compliant	1,507	0	n/a	n/a	1.39	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,425	0	1.5	0.00	1.34	0.05	$361	1.16	2.00
	Efficiency-Equipment	1,369	0	1.5	0.00	1.31	0.08	$361	1.71	1.98
	Efficiency & PV	450	0	10.5	0.60	1.09	0.30	$2,371	1.31	1.79
	Efficiency & PV/Battery	(4)	0	23.0	0.93	0.63	0.76	$5,395	1.27	1.69
Mixed Fuel to All-Electric[3]	Code Compliant	1,507	0	0.0	0.00	1.39	0.90	($2,337)	3.35	2.36
	Efficiency & PV	56	0	10.5	0.60	1.09	1.20	$34	70.89	>1
	Neutral Cost	372	0	10.5	0.70	1.10	1.19	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 10 SDGE

Table 69: Single Family Climate Zone 10 SDGE Results Summary

Climate Zone 10 SDG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	239	n/a	n/a	1.61	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	217	3.0	(0.07)	1.48	0.13	$1,648	0.80	1.33
	Efficiency-Equipment	(0)	209	3.0	(0.06)	1.45	0.16	$593	2.64	3.84
	Efficiency & PV/Battery	(12)	217	9.5	0.03	1.25	0.36	$5,522	0.58	1.48
All-Electric[2]	Code Compliant	2,981	0	n/a	n/a	0.94	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,673	0	3.0	0.00	0.88	0.07	$1,773	1.08	1.52
	Efficiency-Equipment	2,563	0	3.0	0.00	0.85	0.10	$949	2.62	3.19
	Efficiency & PV	762	0	11.0	1.17	0.70	0.24	$6,405	1.68	1.50
	Efficiency & PV/Battery	(6)	0	21.0	1.74	0.41	0.53	$12,129	1.42	1.51
Mixed Fuel to All-Electric[3]	Code Compliant	2,981	0	0.0	0.00	0.94	0.67	($5,349)	0.90	2.66
	Efficiency & PV	762	0	11.0	1.17	0.70	0.91	$1,057	4.55	>1
	Neutral Cost	770	0	9.0	1.36	0.74	0.87	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 70: Multifamily Climate Zone 10 SDGE Results Summary (Per Dwelling Unit)

Climate Zone 10 SDG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	112	n/a	n/a	2.29	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	108	1.5	(0.02)	2.23	0.06	$278	1.09	1.69
	Efficiency-Equipment	(0)	102	2.5	(0.04)	2.13	0.16	$250	2.60	3.27
	Efficiency & PV/Battery	(6)	108	10.0	0.03	1.88	0.41	$2,376	0.23	1.57
All-Electric[2]	Code Compliant	1,507	0	n/a	n/a	1.39	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,425	0	1.5	0.00	1.34	0.05	$361	1.53	2.00
	Efficiency-Equipment	1,369	0	1.5	0.00	1.31	0.08	$361	2.05	1.98
	Efficiency & PV	450	0	10.5	0.60	1.09	0.30	$2,371	2.12	1.79
	Efficiency & PV/Battery	(4)	0	23.0	0.93	0.63	0.76	$5,395	1.44	1.69
Mixed Fuel to All-Electric[3]	Code Compliant	1,507	0	0.0	0.00	1.39	0.90	($2,337)	0.73	2.36
	Efficiency & PV	56	0	10.5	0.60	1.09	1.20	$34	54.15	>1
	Neutral Cost	372	0	10.5	0.70	1.10	1.19	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 11

Table 71: Single Family Climate Zone 11 Results Summary

Climate Zone 11 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel [1]	Code Compliant	(0)	378	n/a	n/a	2.14	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	333	4.0	(0.19)	1.90	0.24	$3,143	0.78	1.20
	Efficiency-Equipment	0	320	5.0	(0.21)	1.83	0.31	$1,222	2.50	3.68
	Efficiency & PV/Battery	(18)	333	9.0	(0.09)	1.78	0.36	$7,026	0.36	1.51
All-Electric [2]	Code Compliant	4,585	0	n/a	n/a	1.15	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,815	0	4.5	0.00	0.99	0.16	$3,735	1.24	1.47
	Efficiency-Equipment	3,533	0	5.5	0.00	0.93	0.22	$2,108	2.97	3.33
	Efficiency & PV	957	0	14.0	1.79	0.60	0.55	$10,827	1.84	1.55
	Efficiency & PV/Battery	(13)	0	23.0	2.49	0.36	0.79	$17,077	1.49	1.61
Mixed Fuel to All-Electric [3]	Code Compliant	4,585	0	0.0	0.00	1.15	0.99	($5,349)	0.49	1.69
	Efficiency & PV	957	0	14.0	1.79	0.60	1.54	$5,478	1.64	>1
	Neutral Cost	2,429	0	7.0	1.36	0.85	1.29	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 72: Multifamily Climate Zone 11 Results Summary (Per Dwelling Unit)

Climate Zone 11 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	141	n/a	n/a	2.38	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	127	2.5	(0.05)	2.18	0.20	$850	0.65	1.17
	Efficiency-Equipment	(0)	126	3.0	(0.06)	2.16	0.22	$317	1.84	3.29
	Efficiency & PV/Battery	(9)	127	10.5	0.01	2.00	0.38	$2,950	0.39	1.60
All-Electric[2]	Code Compliant	1,974	0	n/a	n/a	1.42	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,732	0	3.5	0.00	1.29	0.13	$1,011	1.40	1.64
	Efficiency-Equipment	1,707	0	3.5	0.00	1.26	0.16	$795	2.02	2.33
	Efficiency & PV	504	0	13.0	0.77	0.81	0.61	$3,601	2.22	1.81
	Efficiency & PV/Battery	(6)	0	25.0	1.14	0.45	0.98	$6,759	1.42	1.81
Mixed Fuel to All-Electric[3]	Code Compliant	1,974	0	0.0	0.00	1.42	0.96	($2,337)	0.56	1.33
	Efficiency & PV	63	0	13.0	0.77	0.81	1.56	$1,264	3.03	>1
	Neutral Cost	866	0	9.0	0.70	0.99	1.38	$0	>1	73.96

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 12

Table 73: Single Family Climate Zone 12 Results Summary

Climate Zone 12 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	390	n/a	n/a	2.11	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	344	3.5	(0.06)	1.88	0.23	$1,679	1.18	1.83
	Efficiency-Equipment	0	338	3.0	(0.05)	1.85	0.26	$654	3.31	4.65
	Efficiency & PV/Battery	(23)	344	9.5	0.04	1.76	0.35	$5,568	0.43	1.72
All-Electric[2]	Code Compliant	4,492	0	n/a	n/a	1.05	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,958	0	3.5	0.00	0.94	0.10	$3,735	0.78	1.06
	Efficiency-Equipment	3,721	0	5.0	0.00	0.90	0.15	$2,108	2.00	2.51
	Efficiency & PV	867	0	15.5	1.97	0.51	0.53	$11,520	1.69	1.41
	Efficiency & PV/Battery	(15)	0	25.0	2.62	0.29	0.76	$17,586	1.29	1.48
Mixed Fuel to All-Electric[3]	Code Compliant	4,492	0	0.0	0.00	1.05	1.07	($5,349)	0.63	1.89
	Efficiency & PV	867	0	15.5	1.97	0.51	1.60	$6,172	1.77	>1
	Neutral Cost	2,374	0	8.0	1.35	0.76	1.36	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 74: Multifamily Climate Zone 12 Results Summary (Per Dwelling Unit)

Climate Zone 12 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	143	n/a	n/a	2.33	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	135	1.5	(0.02)	2.21	0.12	$291	1.10	2.22
	Efficiency-Equipment	0	128	2.5	(0.03)	2.12	0.21	$434	1.25	2.22
	Efficiency & PV/Battery	(11)	135	10.0	0.03	2.03	0.30	$2,394	0.30	1.75
All-Electric[2]	Code Compliant	1,963	0	n/a	n/a	1.34	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,792	0	2.5	0.00	1.24	0.09	$1,011	0.91	1.12
	Efficiency-Equipment	1,744	0	2.5	0.00	1.21	0.13	$795	1.56	1.63
	Efficiency & PV	472	0	14.0	0.84	0.73	0.60	$3,835	2.08	1.65
	Efficiency & PV/Battery	(8)	0	26.5	1.20	0.38	0.96	$6,943	1.26	1.68
Mixed Fuel to All-Electric[3]	Code Compliant	1,963	0	0.0	0.00	1.34	1.00	($2,337)	0.64	1.66
	Efficiency & PV	59	0	14.0	0.84	0.73	1.60	$1,498	2.88	>1
	Neutral Cost	872	0	9.5	0.70	0.92	1.42	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 13

Table 75: Single Family Climate Zone 13 Results Summary

Climate Zone 13 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel [1]	Code Compliant	(0)	352	n/a	n/a	2.02	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	311	4.5	(0.21)	1.80	0.22	$3,060	0.76	1.28
	Efficiency-Equipment	(0)	292	5.5	(0.24)	1.70	0.32	$611	5.26	8.40
	Efficiency & PV/Battery	(19)	311	9.5	(0.11)	1.69	0.33	$6,954	0.36	1.56
All-Electric [2]	Code Compliant	4,180	0	n/a	n/a	1.08	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,428	0	5.0	0.00	0.92	0.15	$4,154	1.12	1.40
	Efficiency-Equipment	3,177	0	6.0	0.00	0.87	0.21	$2,108	2.88	3.30
	Efficiency & PV	934	0	13.0	1.61	0.57	0.50	$10,532	1.70	1.47
	Efficiency & PV/Battery	(11)	0	22.0	2.32	0.35	0.73	$16,806	1.40	1.54
Mixed Fuel to All-Electric [3]	Code Compliant	4,180	0	0.0	0.00	1.08	0.94	($5,349)	0.54	1.83
	Efficiency & PV	934	0	13.0	1.61	0.57	1.44	$5,184	1.56	>1
	Neutral Cost	2,092	0	7.0	1.36	0.79	1.23	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 76: Multifamily Climate Zone 13 Results Summary (Per Dwelling Unit)

Climate Zone 13 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	135	n/a	n/a	2.30	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	123	3.0	(0.05)	2.12	0.18	$831	0.63	1.27
	Efficiency-Equipment	(0)	121	3.0	(0.07)	2.10	0.21	$290	1.95	3.75
	Efficiency & PV/Battery	(9)	123	10.5	0.00	1.95	0.35	$2,936	0.38	1.64
All-Electric[2]	Code Compliant	1,849	0	n/a	n/a	1.36	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,629	0	3.0	0.00	1.24	0.12	$1,011	1.31	1.56
	Efficiency-Equipment	1,590	0	3.5	0.00	1.21	0.16	$795	1.98	2.28
	Efficiency & PV	501	0	12.0	0.73	0.80	0.56	$3,462	2.12	1.71
	Efficiency & PV/Battery	(5)	0	23.5	1.11	0.44	0.92	$6,650	1.35	1.74
Mixed Fuel to All-Electric[3]	Code Compliant	1,849	0	0.0	0.00	1.36	0.94	($2,337)	0.63	1.54
	Efficiency & PV	63	0	12.0	0.73	0.80	1.50	$1,125	3.22	>1
	Neutral Cost	773	0	8.5	0.70	0.94	1.36	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 14 SCE/SoCalGas

Table 77: Single Family Climate Zone 14 SCE/SoCalGas Results Summary

Climate Zone 14 SCE/SoCalGas Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	371	n/a	n/a	2.35	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	319	4.5	(0.17)	2.06	0.29	$1,662	1.57	2.46
	Efficiency-Equipment	(0)	305	5.5	(0.19)	1.98	0.36	$799	3.95	6.14
	Efficiency & PV/Battery	(5)	319	9.0	(0.08)	1.83	0.52	$5,526	1.31	1.74
All-Electric[2]	Code Compliant	4,725	0	n/a	n/a	1.38	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,819	0	5.5	0.00	1.19	0.19	$4,154	0.95	1.46
	Efficiency-Equipment	3,676	0	6.0	0.00	1.16	0.22	$2,108	2.29	3.13
	Efficiency & PV	953	0	15.5	1.60	0.93	0.45	$10,459	1.21	1.62
	Efficiency & PV/Battery	(2)	0	23.5	2.21	0.63	0.75	$16,394	1.35	1.59
Mixed Fuel to All-Electric[3]	Code Compliant	4,725	0	0.0	0.00	1.38	0.97	($5,349)	0.72	1.67
	Efficiency & PV	953	0	15.5	1.60	0.93	1.42	$5,111	1.01	>1
	Neutral Cost	2,299	0	8.5	1.35	1.15	1.19	$0	0.00	>1
	Min Cost Effectiveness	1,853	0	10.0	1.61	1.12	1.23	($1,000)	1.24	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, Neutral Cost, and Min Cost Effectiveness packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 78: Multifamily Climate Zone 14 SCE/SoCalGas Results Summary (Per Dwelling Unit)

Climate Zone 14 SCE/SoCalGas Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	141	n/a	n/a	2.76	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	126	3.0	(0.04)	2.53	0.23	$874	0.73	1.21
	Efficiency-Equipment	(0)	126	3.0	(0.05)	2.52	0.23	$347	1.96	2.99
	Efficiency & PV/Battery	(3)	126	9.5	0.01	2.18	0.58	$2,957	1.09	1.39
All-Electric[2]	Code Compliant	2,022	0	n/a	n/a	1.73	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,759	0	3.5	0.00	1.58	0.15	$1,011	1.24	1.65
	Efficiency-Equipment	1,748	0	3.5	0.00	1.56	0.16	$795	1.59	2.20
	Efficiency & PV	504	0	14.0	0.70	1.26	0.47	$3,356	1.39	1.91
	Efficiency & PV/Battery	(2)	0	24.5	1.03	0.79	0.94	$6,380	1.36	1.77
Mixed Fuel to All-Electric[3]	Code Compliant	2,022	0	0.0	0.00	1.73	1.03	($2,337)	1.13	1.48
	Efficiency & PV	63	0	14.0	0.70	1.26	1.50	$1,019	2.57	>1
	Neutral Cost	772	0	10.0	0.70	1.41	1.35	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 14 SDGE

Table 79: Single Family Climate Zone 14 SDGE Results Summary

Climate Zone 14 SDG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	371	n/a	n/a	2.35	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	319	4.5	(0.17)	2.06	0.29	$1,662	1.92	2.46
	Efficiency-Equipment	(0)	305	5.5	(0.19)	1.98	0.36	$799	4.88	6.14
	Efficiency & PV/Battery	(5)	319	9.0	(0.08)	1.83	0.52	$5,526	1.23	1.74
All-Electric[2]	Code Compliant	4,725	0	n/a	n/a	1.38	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	3,819	0	5.5	0.00	1.19	0.19	$4,154	1.30	1.46
	Efficiency-Equipment	3,676	0	6.0	0.00	1.16	0.22	$2,108	2.92	3.13
	Efficiency & PV	953	0	15.5	1.60	0.93	0.45	$10,459	1.80	1.62
	Efficiency & PV/Battery	(2)	0	23.5	2.21	0.63	0.75	$16,394	1.67	1.59
Mixed Fuel to All-Electric[3]	Code Compliant	4,725	0	0.0	0.00	1.38	0.97	($5,349)	0.60	1.67
	Efficiency & PV	953	0	15.5	1.60	0.93	1.42	$5,111	1.94	>1
	Neutral Cost	2,299	0	8.5	1.35	1.15	1.19	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 80: Multifamily Climate Zone 14 SDGE Results Summary (Per Dwelling Unit)

Climate Zone 14 SDG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	141	n/a	n/a	2.76	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	126	3.0	(0.04)	2.53	0.23	$874	0.93	1.21
	Efficiency-Equipment	(0)	126	3.0	(0.05)	2.52	0.23	$347	2.48	2.99
	Efficiency & PV/Battery	(3)	126	9.5	0.01	2.18	0.58	$2,957	0.51	1.39
All-Electric[2]	Code Compliant	2,022	0	n/a	n/a	1.73	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,759	0	3.5	0.00	1.58	0.15	$1,011	1.47	1.65
	Efficiency-Equipment	1,748	0	3.5	0.00	1.56	0.16	$795	2.00	2.20
	Efficiency & PV	504	0	14.0	0.70	1.26	0.47	$3,356	2.16	1.91
	Efficiency & PV/Battery	(2)	0	24.5	1.03	0.79	0.94	$6,380	1.69	1.77
Mixed Fuel to All-Electric[3]	Code Compliant	2,022	0	0.0	0.00	1.73	1.03	($2,337)	0.51	1.48
	Efficiency & PV	63	0	14.0	0.70	1.26	1.50	$1,019	2.60	>1
	Neutral Cost	772	0	10.0	0.70	1.41	1.35	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 15

Table 81: Single Family Climate Zone 15 Results Summary

Climate Zone 15 SCE/SoCalGas Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	149	n/a	n/a	1.69	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	141	4.5	(0.43)	1.56	0.13	$2,179	1.00	1.58
	Efficiency-Equipment	(0)	132	4.5	(0.45)	1.51	0.18	($936)	>1	>1
	Efficiency & PV/Battery	(3)	141	7.0	(0.34)	1.38	0.32	$6,043	1.15	1.51
All-Electric[2]	Code Compliant	2,149	0	n/a	n/a	1.32	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	1,230	0	5.5	0.00	1.12	0.20	$4,612	1.12	1.58
	Efficiency-Equipment	866	0	7.0	0.00	1.04	0.28	$2,108	3.30	4.47
	Efficiency & PV	1,030	0	6.0	0.12	1.10	0.22	$5,085	1.12	1.57
	Efficiency & PV/Battery	(2)	0	13.0	0.83	0.84	0.48	$11,382	1.16	1.54
Mixed Fuel to All-Electric[3]	Code Compliant	2,149	0	0.0	0.00	1.32	0.37	($5,349)	1.73	2.21
	Efficiency & PV	1,030	0	6.0	0.12	1.10	0.59	($264)	>1	>1
	Neutral Cost	23	0	6.0	1.36	1.13	0.57	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 82: Multifamily Climate Zone 15 Results Summary (Per Dwelling Unit)

Climate Zone 15 SCE/SoCalGas Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	93	n/a	n/a	2.53	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	92	4.0	(0.15)	2.42	0.11	$510	1.35	2.28
	Efficiency-Equipment	0	86	4.0	(0.16)	2.33	0.20	($157)	>1	>1
	Efficiency & PV/Battery	(3)	92	8.5	(0.10)	2.13	0.40	$2,604	1.29	1.70
All-Electric[2]	Code Compliant	1,243	0	n/a	n/a	1.78	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	954	0	4.0	0.00	1.61	0.17	$1,011	1.50	2.28
	Efficiency-Equipment	764	0	6.0	0.00	1.50	0.29	$1,954	1.24	1.72
	Efficiency & PV	548	0	7.0	0.24	1.50	0.28	$1,826	1.43	2.07
	Efficiency & PV/Battery	(3)	0	16.5	0.62	1.08	0.70	$5,020	1.34	1.80
Mixed Fuel to All-Electric[3]	Code Compliant	1,243	0	0.0	0.00	1.78	0.75	($2,337)	6.36	2.35
	Efficiency & PV	68	0	7.0	0.24	1.50	1.03	($511)	>1	>1
	Neutral Cost	78	0	7.5	0.70	1.48	1.05	$0	>1	>1

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Climate Zone 16

Table 83: Single Family Climate Zone 16 Results Summary

Climate Zone 16 PG&E Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	605	n/a	n/a	3.31	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	0	454	5.0	0.01	2.59	0.72	$3,542	1.62	1.46
	Efficiency-Equipment	0	474	6.0	(0.08)	2.66	0.65	$2,441	2.19	2.20
	Efficiency & PV/Battery	(18)	454	10.5	0.10	2.36	0.95	$7,399	0.87	1.37
All-Electric[2]	Code Compliant	7,694	0	n/a	n/a	1.73	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	5,696	0	9.5	0.00	1.38	0.35	$5,731	1.72	1.69
	Efficiency-Equipment	6,760	0	4.5	0.00	1.55	0.18	$2,108	2.36	2.32
	Efficiency & PV	1,032	0	26.5	2.75	0.94	0.79	$16,582	2.09	1.62
	Efficiency & PV/Battery	(11)	0	35.0	3.45	0.64	1.09	$22,838	1.71	1.55
Mixed Fuel to All-Electric[3]	Code Compliant	7,694	0	0.0	0.00	1.73	1.58	($5,349)	0.31	0.68
	Efficiency & PV	1,032	0	26.5	2.75	0.94	2.37	$11,234	1.55	2.02
	Neutral Cost	5,398	0	8.5	1.35	1.51	1.80	$0	0.00	0.74
	Min Cost Effectiveness	3,358	0	16.0	2.56	1.32	1.99	($4,753)	1.24	1.40

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, Neutral Cost, and Min Cost Effectiveness packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 84: Multifamily Climate Zone 16 Results Summary (Per Dwelling Unit)

Climate Zone 16 PG&E Multifamily		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		NPV of Lifetime Incremental Cost ($)	Benefit to Cost Ratio (B/C)	
						Total	Reduction		On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	206	n/a	n/a	3.45	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	(0)	172	2.0	0.03	3.02	0.44	$937	1.11	1.19
	Efficiency-Equipment	(0)	183	2.5	(0.02)	3.12	0.33	$453	1.76	2.15
	Efficiency & PV/Battery	(9)	172	9.5	0.08	2.65	0.80	$3,028	0.47	1.28
All-Electric[2]	Code Compliant	2,699	0	n/a	n/a	1.86	n/a	n/a	n/a	n/a
	Efficiency-Non-Preempted	2,329	0	4.0	0.00	1.70	0.16	$843	2.08	2.05
	Efficiency-Equipment	2,470	0	3.0	0.00	1.74	0.13	$795	1.59	1.70
	Efficiency & PV	518	0	19.5	1.07	1.23	0.63	$4,423	2.58	1.89
	Efficiency & PV/Battery	(6)	0	29.5	1.42	0.75	1.11	$7,533	1.65	1.69
Mixed Fuel to All-Electric[3]	Code Compliant	2,699	0	0.0	0.00	1.86	1.59	($2,337)	0.43	1.03
	Efficiency & PV	65	0	19.5	1.07	1.23	2.22	$2,087	2.87	>1
	Neutral Cost	1,518	0	10.0	0.70	1.56	1.90	$0	>1	2.58

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except the EDR Margins are relative to the Standard Design for each case which is the **all-electric** code compliant home. Incremental costs for these packages reflect the cots used in the On-Bill cost effectiveness methodology. Costs differ for the TDV methodology due to differences in the site gas infrastructure costs (see Section 2.6).
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Energy Solutions

Electric Vehicle Infrastructure Cost Analysis Report for Peninsula Clean Energy (PCE) & Silicon Valley Clean Energy (SVCE)

To: Peninsula Clean Energy & Silicon Valley Clean Energy

From: Tim Minezaki, Engineer II

Cassidee Kido, Project Manager

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Energy Solutions

Date: November 20, 2019

[1] Ed Pike contributed to this project while an employee at Energy Solutions.

Table of Contents

1. Executive Summary

California and the Bay Area are on the verge of a massive transformation. Current estimates[2] put electric vehicles (EVs) and plug-in hybrid vehicles (PHEVs) at a 5% market share but by 2030, that is expected to grow to 18-20%. Access to electric vehicles (EV) infrastructure is currently a major barrier for consumers' willingness to purchase electric vehicles. Meanwhile, several studies show that installation of EV infrastructure has significant costs, most notably in a retrofit scenario which has multiple cost factors. This report investigates infrastructure costs associated with EV infrastructure reach codes by building an EV cost effectiveness model, which examined three common building types and applied different EV infrastructure penetration rates. The model also studied utility-side infrastructure, such as distribution transformers, that potentially yield additional costs and affect a building owner's ability to comply with expanded EV infrastructure adoption, to understand the scale and frequency of those costs.

EV Infrastructure: New Construction vs. Retrofit: Customer costs

The cost effectiveness model compared three building scenarios: (1) a medium 60-unit multi-unit dwelling (MUD) with 60 parking spaces, (2) a high-density 150-unit MUD with 150 parking spaces, and (3) a medium commercial office building with 60 parking spots. The model compares customer-side electrical infrastructure costs, such as wiring, switch gear, conduit, trenching, and secondary transformer. Primary transformer costs which are usually the responsibility of utilities, were considered separately in a later section[3].The building models were then analyzed to compare the new construction requirements with the retrofit requirements. Results from Table 1 below show that costs for new construction were significantly lower, at almost four times as much per spot compared to the retrofit scenario. This indicates that increasing code requirements for charging infrastructure could potentially save significant amounts of money to building owners in the new construction context rather than waiting for tenants to become interested in electric vehicles, at which point significant costs related to invasive demolition and electrical infrastructure replacement would be necessary.

Table 1. Estimated Cost of Installing EV Infrastructure (price per spot)

Code Scenario:	Market Rate 25% Level 2 75% Level 1		Affordable Housing 10% Level 2 90% Level 1	
Building Type	New Construction	Retrofit[4]	New Construction	Retrofit
60-Unit MUD	$1,410	$4,443	$1,049	+$3,982
150-Unit MUD	$1,197	$4,101	$1,002	+$3,854
60-Space Office Building	$1,166	$3,232	N/A	N/A

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2 http://businessportal.ca.gov/wp-content/uploads/2019/07/GoBIZ-EVCharging-Guidebook.pdf
3 Primary transformers are owned and operated by the utility and covered in a subsequent section but have cost components that can spill over to customer fees in multiple ways (PG&E Electric Rule 16).
4 "New Construction" and "Retrofit" costs are relative to a CALGreen 2019 mandatory baseline building

In a retrofit context, there are significant known costs, such as those documented in this infrastructure costing model, but there are a high level of unknown opaque costs that either are born by the utility or by the customer, which while infrequent, can cause significant burden on a small number of building owners and tenants that are not present in New Construction projects. In addition, retrofitting parking structures for Americans with Disabilities Act (ADA) compliance can be a significant source of costs. Recent large-scale pilot studies conducted by the California utilities confirmed these cost burdens. For example, Pacific Gas & Electric's (PG&E) EV Charge Ready program reported an "Average Cost per Port" costs for retrofit projects in their program to be almost $18,000[5] with a range between $10,000 and $31,000[6]. The utility reports specifically call out ADA requirements and inconsistent requirements across jurisdictions, which required significant redesign costs for ADA compliance.

EV Infrastructure: Building size / Transformers

Distribution transformers are a key piece of EV infrastructure and their costs and magnitude are heavily influenced by building size. For most situations, small buildings utilize shared distribution transformers split between multiple electrical accounts; medium buildings feature a dedicated utility-owned transformer and large buildings may feature several transformers, some are utility-owned and some are customer-owned depending on the uses and electrical design of the building. The particular trigger points between building sizes are influenced by the utility rules on electrical infrastructure equipment specifications and are not comparative between utilities. The graph below illustrates when certain costs become important to assist policy makers:

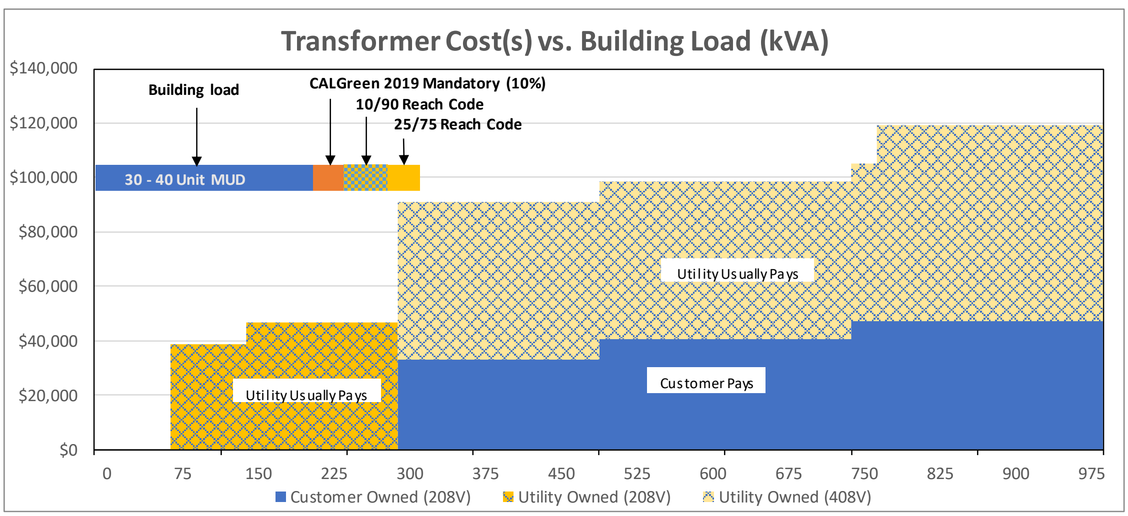

Figure 1: Costs of Transformers vs. Transformer system size (PG&E service territory)[7]

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[5] Note that these costs include extensive design and re-design as well as utility side costs: Pacific Gas and Electric Company EV Charge Network Quarterly Report (Q1-2019)

[6] Q2 2019 Clean Transportation Program Advisory Council Meeting

[7] This graph shows PG&E's specific equipment sizing and is not comparable to other utilities. Calculations are based on estimates from the infrastructure cost model.

Costs of distribution and/or service-line upgrades are partially split between customer and utility. Customers are responsible for excavation, conduits, and protective structures. Utilities are typically responsible for wiring, metering, and transformer(s) (where necessary), however, utility costs can spill over into customer costs anytime that the costs exceed the preset “allowance” for a customer, based on historical energy usage.[8] In addition, if new load, does not materialize, the utility is able to assess additional charges for the difference in expected revenue. Currently, costs are described by California Public Utilities Commission’s (CPUC) Electric Rules 2, 15, and 16 which lay out which party is responsible for these costs, however, these costs are complicated, opaque, and hard to predict. Luckily,the CPUC is tracking costs related to EV infrastructure and has found that utility-side infrastructure upgrades triggered by EV-only projects are rare. To date, for PG&E’s service territory found only 3% of projects required distribution or service-line upgrades to accommodate EV infrastructure. However those costs spanned a wide cost range from $14 to $338,274 (additional details on this study can be found in the Transformers section below).

Reach Code Context

This study investigated EV-infrastructure reach codes for communities in the jurisdiction of Silicon Valley Clean Energy (SVCE) and Peninsula Clean Energy (PCE), shown in Table 4 below. The study found that increasing the electric vehicle infrastructure requirements for new construction will save significant costs for all buildings when compared to a retrofitting. The study also found that transformer capacity limitations are not expected to occur very frequently and that even in the retrofit context most buildings should be able to meet the added load. For those that do not have significant capacity, utilizing lower power “Level 1” ports or load management may be a promising options.

Buildings near the boundary conditions highlighted above in Figure 1, in particular those that approach the 300 kVA capacity size[9], face added risk of electrical infrastructure upgrade costs. For owners of those new buildings, the electrical systems would have to accommodate a second transformer and associated electrical infrastructure and the owner/developer would need to bear those costs estimated to be approximately $50,000 (or significantly more in a retrofit context).

[8] Customers have an “allowance” based on their billing history to fund utility upgrades, but if allowance costs are exceeded, they are charged directly to the customer (PG&E Electric Rule 15 & Rule 16). This allowance is based on the net revenue of the customer account. In addition, if the expected load does not materialize to use the system upgrade, the utility is permitted to recover their costs from the customer.
[9] For example, for a 30-40 unit MUD, this may be a consideration as shown in Figure 1.

2. Background and Purpose

Purpose

The purpose of this report is to provide cost analysis data on electric vehicle infrastructure and to support and inform potential adoption of reach codes for cities and municipalities in Santa Clara and San Mateo counties. This report investigates potential reach codes that would 1) require "EV-ready" parking spaces, parking spaces which are already equipped with wiring and simply need an electric vehicle supply equipment (EVSE) to provide charging, and 2) increase the EV charging space requirements for market-rate housing, affordable housing, and commercial-office buildings. The CALGreen nonresidential code currently requires only that "EV capable" parking spaces be provided, which requires conduit and electrical panel capacity for a 40 ampere, 208/240-volt circuit serving the space, but does not require wiring nor EVSE installation and associated expenses. The following table describes these EV equipment tiers:

EV Capable	Includes conduit / raceways
EV Ready ("Plug and play")	Includes full circuit with a receptacle / outlet
EV Installed	Includes full charging capability with EVSE

This cost report estimates the incremental costs associated with expanding EV infrastructure requirements beyond existing CALGreen 2019 mandatory requirements and compares the incremental construction costs from a new construction project with those of a retrofit project, utilizing an EV infrastructure cost model for three prototype buildings: (1) a 60-unit medium MUD, (2) a 150-unit large MUD, and (3) a medium-sized commercial office with 60 parking spaces. In all residential cases, we assumed one parking space per unit was assumed.

In addition, the report also investigates distribution current transformers, which will be increasingly important as electrical loads increase due to building and transportation electrification. Specifically, the utility rules and electrical load requirements were analyzed to determine boundary conditions where transformers would be required, the relative cost to incorporate them, and points at which multiple current transformers may be required, and the relative magnitude of those costs. The report also delineates specific situations for when transformers are utility owned and when they become a customer costs

California's EV Infrastructure Policy Goals

The increased proliferation of EV charging infrastructure supports many of California's zero-emission vehicle adoption goals, including the objective to deploy 1.5 million zero-emission vehicles and 250,000 publicly available EV charging stations including 10,000 direct current (DC) fast chargers by 2025.[10] California also has a goal of deploying 5 million ZEVs by 2030, which will require an even larger scale-up of public stations in addition to millions of non-public EV charging stations.[11] As of October 2019, California had approximately 18,500 public Level 2 charging ports at over 5,000 locations and approximately 3,200 public DC fast charging stations at over 700 locations.[12] California must make significant progress quickly, including updating CALGreen requirements and for local communities, investigating reach codes and the potential costs.

Parking spaces at workplaces and other non-residential buildings will be needed to accommodate a California vehicle fleet that is expected to have 18%-24% ZEVs in 2030. The future percentage of ZEVs will require a much higher percentage of parking spaces than the current CALGreen code requirements.[13]

EV charging infrastructure is a critical policy to help California reach its climate and EV adoption goals by providing opportunities at homes and workplaces as well as overcoming the critical challenge of "range anxiety" associated with EV adoption.[14] Surveys of communities in the Bay Area have shown that access to vehicle charging remains a main hurdle to wider adoption and in spite of that electric vehicle adoption is expected to grow significantly.

Building codes are an important way to facilitate access to EV charging so that residents, commuters, fleets, and car-sharing services can benefit from the significant operating cost advantages in a way that is cost-effective and accessible for all. Furthermore, because EV capable parking spaces can avoid or greatly reduce several types of costs associated with installing EV charging stations, public and private funding can achieve greater number of EV charging stations faster and more efficiently. Thus, increasing the levels of EV capable parking spaces beyond those set by CALGreen will lead to significant increases in EV charging infrastructure.

CALGreen and Beyond

CALGreen is the first mandatory green building standards code in the nation and often serves as a model for other state and local governments across the county. It was originally developed in 2007 by the California Building Standards Commission (CBSC) to help meet the goals of AB 32 in reducing greenhouse gases to 1990 levels by 2020.[15] Every three years, the CALGreen code is reviewed, revised, and adopted statewide

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[10] Former Governor Edmund G. Brown Jr. Executive Order B-16-2012 set the goal of placing 1.5 million zero-emission vehicles on California's roads by 2025. Former Governor Edmund G. Brown's Executive Order B-48-18 set the goal of 250,000 electric vehicle charging stations, including 10,000 DCFC charging stations, by 2025. In addition, the Charge Ahead California Initiative, [SB 1275 (De León), Chapter 530, Statutes of 2014] set a goal of placing 1 million zero- and near-zero-emission vehicles into service on California's roads by 2023.

[11] Former Governor Edmund G. Brown Jr. Executive Order B-48-18 set the goal of 5 million zero-emission vehicles on California's roads by 2030.

[12] Statistics are from the Alternative Fueling Station Locator (August 2019): https://afdc.energy.gov/stations/#/analyze?region=US-CA&fuel=ELEC&ev_levels=dc_fast&country=US

[13] The California Air Resources Board's EMFAC2017 database estimates that 21.0 million "LDA" (automobiles) and "LDT1" (light duty trucks) will be on the road in 2030. The database also estimates that 6.3 million additional "LDT2" (a second category of light duty trucks) will be on the road, some of which could be used for workplace commuting or other trips to non-residential buildings.

[14] "Range anxiety" refers to concerns about insufficient range and inability to find EV charging stations.

[15] "CALGreen", Department of General Service, https://www.dgs.ca.gov/BSC/Resources/Page-Content/Building-Standards-Commission-Resources-List-Folder/CALGreen

along with other sections of Title 24 for residential and nonresidential buildings. The latest version of the CALGreen code takes effect on January 1, 2020 and is referred to by CBSC as "CALGreen 2019."

The nonresidential CALGreen EV capable infrastructure requirements (California Code of Regulations, Title 24, Part 11 Sections 5.106 and A5.106) and the multifamily requirements (California Code of Regulations, Title 24, Part 11, Sections 4.106 and A4.106) which will take effect January 1, 2020 are shown in Table 2 and Table 3.

Table 2. Summary of Mandatory and Voluntary CALGreen 2019 EV Capable Parking Space Standards for New Construction (Non-Residential)

Current Mandatory	Voluntary Tier 1	Voluntary Tier 2
6%	8%	10%

Table 3. Summary of Mandatory and Voluntary CALGreen 2019 EV Capable Parking Space Standards for New Construction (Residential)

Current Mandatory	Voluntary Tier 1	Voluntary Tier 2
10%	15%	20%

The California Building Standards allow for more restrictive local amendments that are necessary because of local climatic, geological, or topographical conditions. Currently, two dozen municipalities in California have adopted local building codes that require more EV parking spaces than CALGreen and in many cases already require "EV ready" spaces with complete wiring.[16] Given the findings of this report, local jurisdictions that expand upon CALGreen requirements, could yield improved cost-savings potential for local businesses and developers.

As mentioned above, this report investigated the cost effectiveness of "EV reach codes" for market-rate housing, affordable housing, and commercial-office buildings. Table 4 below shows the following code levels that were investigated. Note that the baseline CALGreen 2019 levels are shown in "()" for comparative purposes.

[16] Pike, E. et. al. 2018. Driving Plug-in Electric Vehicle Adoption with Green Building Codes, August 17. ACEEE Summer Conference. Examples of agencies that are proposing local codes include Berkeley, Brisbane, San Jose, San Mateo, and many others.

Table 4. Summary of EV Reach Code Scenarios Analyzed

	MUD Market Rate (25/75)	MUD Affordable Housing (10/90)	Commercial Office
"EV Capable"	(10%)	(10%)	30% (6%)
Level 2	25%	10%	10%, EVSE
Level 1	75%	90%	10%

3. Cost Modeling

Scenarios

The model investigates three prototype building models at the CALGreen 2019 mandatory requirement level. Those models were then analyzed for EV infrastructure installation costs as described in the scenarios described in Table 4 above for a new construction scenario and a retrofit scenario for a total of thirteen runs in the cost model. Table 5 below provides a high-level view of the building prototype models in terms of number of parking spaces, approximate building area, parking lot area, and number of stories. These buildings represent hypothetical building scenarios that are based on several assumptions and may not be reflective of any one building. Please refer to the appendix and methodology for additional details.

Buildings Types Descriptions

60-unit MUD: A 60-unit apartment building with enclosed parking with 60 parking spaces to represent a medium-sized MUD building.

150-unit MUD: A 150-unit apartment building with enclosed parking with 150 parking spaces to representing a large MUD building.

60-space Commercial Office: An open parking lot with 60 spaces, to representing a medium-sized office building.

TRANSFORMER-RELATED DEFINITIONS:

Primary Transformer: A utility-owned transformer used to convert medium voltage utility distribution lines (normally 12kV) to customer level power at either 480V/277V for large buildings or 208V/120V or 240V/120V for medium buildings. Primary transformers are owned and operated by the utility but any upgrade installation costs are partially split with the building owner.

Secondary Transformer: A customer-owned transformer that converts 480V/277V power down to 208V/120V service (or 240V/120V). Usually only necessary for medium-sized or large-sized buildings.

Headroom: Additional space left for transformer sizing to account for future unspecified load, typically 20%.

Table 5. Building Prototypes & Baseline Conditions

Building Type	60-unit MUD	150-unit MUD	60-Space Office
Number of Units	60	150	n/a
Total number of parking spaces required	60	150	60
Building Area [ft²]	65,000	163,000	20,000
Number of Floors	4 to 5	8 to 9	1 to 3
Parking Lot Size [ft²]	14,000	38,800	14,000
Parking Lot Type	1-level structure	2-level structure	stand-alone lot
CALGreen Level 2 Charging Requirement	6	15	4
Building Load [kVA]	292	700	98
CALGreen EV Load [kVA]	43	86	29
Total Load [kVA]	335	786	126
Load with Headroom [kVA]	402	944	152
Percent of load from CalGreen EV Load	11%	11%	18%
Secondary Transformer [kVA] (480V -> 208V / 120V)	500	1000	225
Primary Transformer [kVA] (12kV -> 480V / 277V)	750	1000	300

Table 6. Load Comparisons across Scenarios

Building Type	60-Unit MUD[17]		150-Unit MUD		60-Space Office Building
Baseline Building Load [kVA]	292		700		98
Baseline Level 2 [# of Ports] (CALGreen 2019)	6		15		4
Baseline EV Load [kVA] (CALGreen 2019)	43		86		29
Capacity Requirement (with headroom)	402 kVA		944 kVA		152 kVA
Secondary Transformer Size	500 kVA		1000 kVA		300 kVA
Reach Code Scenario	Market Rate	Affordable Housing	Market Rate	Affordable Housing	10% L2 40% L1
Additional Level 2 Ports	+12 ports	0 ports	+22 ports	0 ports	+2 ports
Additional Level 1 Ports	+45 ports	+54 ports	+113 ports	+135 L1	+24 ports
Additional EV Load [kVA]	+95 kVA	+54 kVA	+257 kVA	+156 kVA	+33 kVA
TOTAL EV Load [kVA]	430 kVA	389 kVA	1043 kVA	942 kVA	160 kVA
Secondary Transformer Size	500 kVA	500 kVA	1500 kVA[18]	1000 kVA	300 kVA
Percent of load from EVs	32%	25%	33%	26%	39%

[17] Some of the capacity loading calculations do not appear additive. For any parking scenario with more than 10 chargers, we utilized a diversity factor of 80% to account for non-coincident charging.
[18] Our cost model assumes that for a retrofit scenario, a second 500 kVA transformer would be installed rather than demolition

Results

The results of the cost analysis model show that installing EV capable spaces as a stand-alone retrofit are close to four times as expensive compared to during new construction. Costs for these project types are shown in Table 7 and Table 9 with detailed breakdowns in Appendix A.

Several factors related to *building types* affect these results:

- Costs per space are generally higher for small buildings with a small number of retrofits for EV capable infrastructure. Smaller projects must divide fixed costs among fewer spaces than larger projects.
- Buildings that are at the cusp of needing an upgraded switch gear or transformers represent **significant cost** increases to add electric vehicles, particularly in a retrofit context where there are large costs from demolition and site disruption. The prototypes we studied were unable to illustrate this point so additional narrative about these costs have been added in the 'Distribution Transformers' section. For this study, the prototype buildings we used only surpassed the baseline transformer capacity on one scenario – and the loading was such that we did not expect significant demolition was not expected. Switch gear and secondary transformer costs were included but did not include added costs for demolition, removal, or expansion of electrical rooms[19] -or- any costs associated with utility-owned primary transformer upgrades[20].
- Our cost model found that enclosed parking was less expensive than an open parking lot. This is because surface-mounted conduit is often less expensive to retrofit than trenching, and repairing surface parking areas. However, enclosed parking is usually much more expensive when considering ADA compliance due to grading, restriping, and accounting for path of travel.

Several factors related to *project type* affect these results:

- Installing conduit in new construction is much less expensive than retrofitting it later for several reasons.
  - Demolition, disposal of materials, and repair of surface parking areas is not required.
  - Conduit can be installed directly underneath parking rather than routing around existing barriers. In addition, less expensive PVC (plastic) conduit can be installed in the parking floor (tied to rebar before concrete is poured) rather than surface mounted later. While wiring of branch circuits is not included in this report, these shorter lengths will also reduce wiring costs.
  - Running conduit through existing buildings will likely require demolition of walls, and potentially through floors as well[21]
  - Requiring that new electrical service panels contain capacity for EV capable infrastructure can achieve economies of scale and avoid the situations where an electrical room must be

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[19] Demolition, Removal, and expansion of electrical rooms were not considered because they are highly dependent on site-specific factors that are difficult to estimate from the generic building prototypes we developed.
[20] Utility-side transformer costs are analyzed in a separate section
[21] X-ray cameras are usually used to prevent damage to concrete structures.

expanded to add additional charging. This latter cost is not included in the model, and thus, some retrofits for EV capable spaces would be significantly more expensive.

- Compared to stand-alone retrofits, incremental "soft" costs will be lower for new construction. This is because fixed costs not related to EV capable spaces will already be required for construction and the incremental cost will be much lower.[22]
- Equipment needed for trenching of surface parking will likely already be on-site during new construction, limiting costs.

Table 7. Incremental Costs Required to Install EV Infrastructure

Code Scenario	Market Rate 25% Level 2 75% Level 1		Affordable Housing 10% Level 2 90% Level 1	
Building Type	New Construction	Retrofit	New Construction	Retrofit
60-Unit MUD	$76,142	$239,909	$56,629	$215,051
150-Unit MUD	$161,550	$553,682	$135,301	$520,227
60-Space Office Building	$34,971	$96,970	N/A	N/A

[22] Pike, Ed and Steuben, Jeff. "Plug-In Electric Vehicle Infrastructure, Cost-Effectiveness Report." 2016

Table 8. Number of EV Charging Ports per Scenario

Code Scenario:	CALGreen 2019	Market Rate 25% Level 2 75% Level 1	Affordable Housing 10% Level 2 90% Level 1
60-Unit MUD	6 L2	15 L2 45 L1	6 L2 54 L1
150-Unit MUD	15 L2	38 L2 112 L1	15 L2 135 L1
60-Space Office Building	4 L2	6 L2 24 L1	N/A

Table 9. Estimated Cost of Installing EV Infrastructure (price per spot)[23]

Code Scenario:	Market Rate 25% Level 2 75% Level 1		Affordable Housing 10% Level 2 90% Level 1	
Building Type	New Construction	Retrofit	New Construction	Retrofit
60-Unit MUD	$1,410	$4,443	$1,049	$3,982
150-Unit MUD	$1,197	$4,101	$1,002	$3,854
60-Space Office Building	$1,166	$3,232	N/A	N/A

Figure 2, 3, and 4 summarize the major categories of costs such as: demolishing and repairing parking lots and sidewalks, upgrading electrical service panels, obtaining permits and inspections, and installing conduit and associated equipment. CALGreen is the baseline cost - all other scenarios are costs *in addition* to the CALGreen baseline. Tables showing the specific dollar amounts and percent of total project cost by category are shown in the Appendix A.

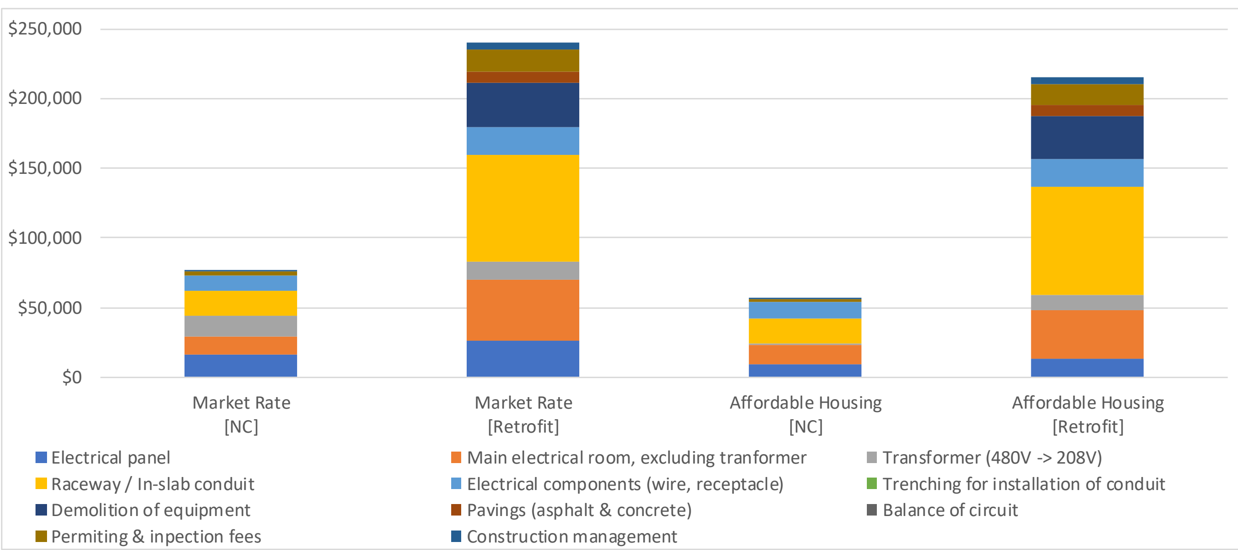

Figure 2. Cost Break-Down for 60-unit MUD

23 Price per spot is calculated against the baseline CALGreen level. For illustrative purposes: 60-unit scenarios are divided by 54 spaces, which represents the incremental number of spaces added for the incremental cost.

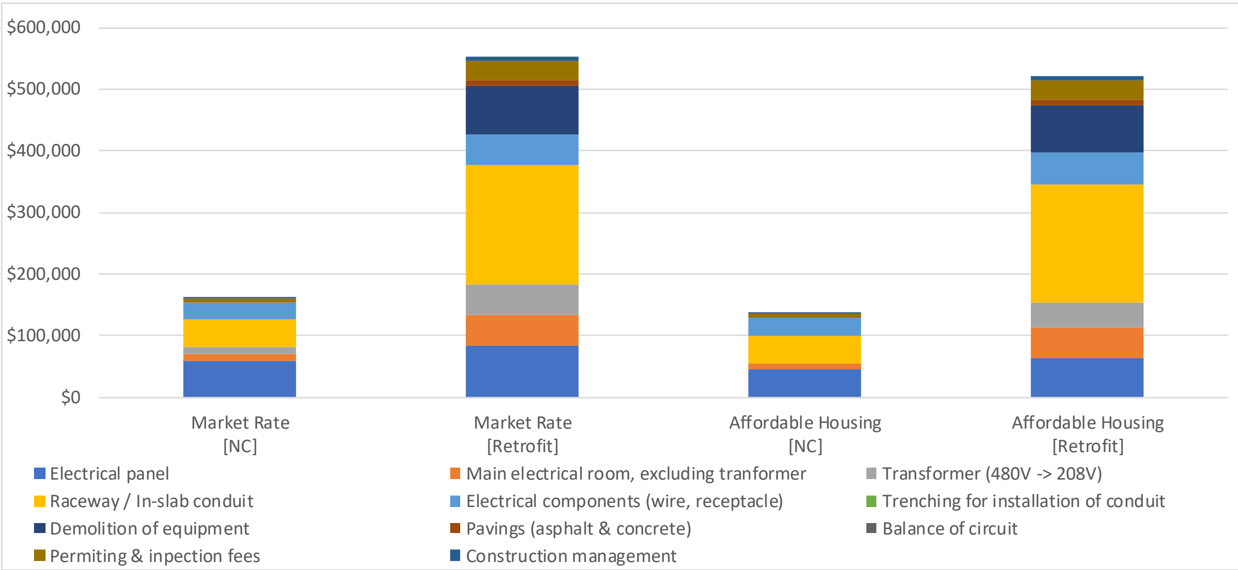

Figure 3. Cost Break-Down for 150-unit MUD

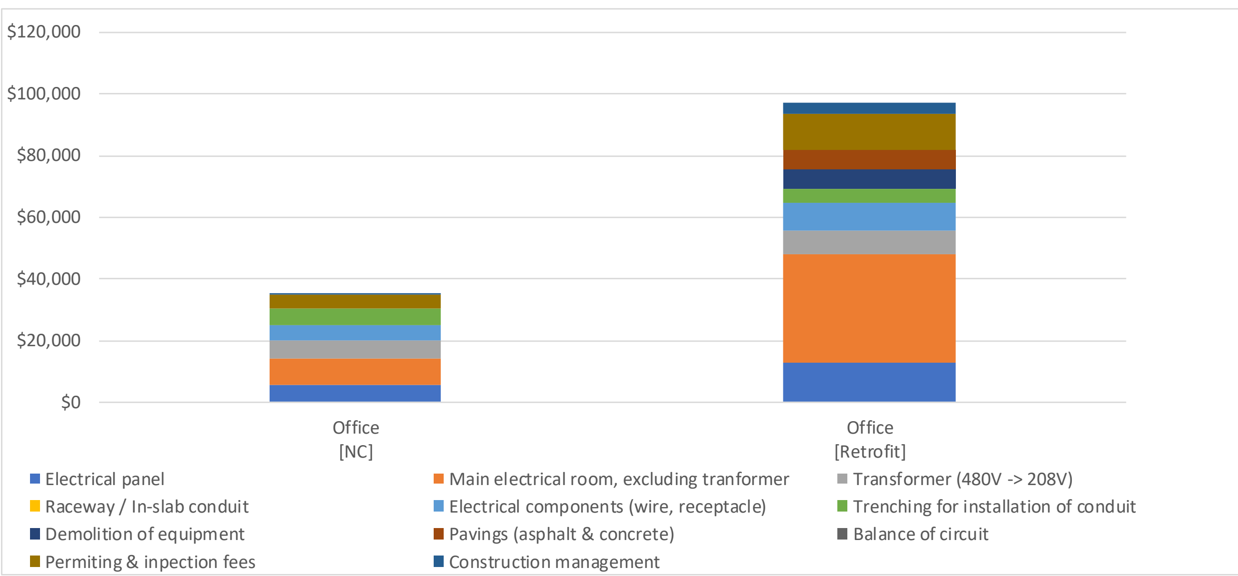

Figure 4. Cost Break-Down for 60-space Commercial Office (assumes surface-level parking)

Building code requirements for EV capable parking spaces can also reduce or avoid non-cost barriers such as coordinating between building owners/operators and tenants, potential loss of productive time for tenants during construction, lack of awareness of EV charging as an option, and the additional time and expense of undertaking a stand-alone EV charging infrastructure construction project. This study does not include specific accessibility requirements such as slope, vertical clearance, and path of travel and any of the associated costs with restriping, curb-cutting, or re-grading to meet ADA requirements, however a rough contingency to account for these ADA requirements has been included. For additional information on ADA compliance, the Governor's Office of Business and Economic Development recently released an Electric

Vehicle Charging Station Permitting Guidebook which highlights several ADA-specific issues around accessibility.[24]

Cost Savings Due to EVSE Installation in New Construction

This section discusses the benefits of requiring EVSE installation in a subset of spaces. This section also discusses the potential benefits of good design practices to greatly reduce the potential for expensive redesign and engineering to meet accessibility requirements for buildings subject to Title 24, Part 2, Chapter 11B.

EVSE Installation

We note that several local jurisdictions already require the complete installation of an EVSE on a complete electrical circuit for some parking spaces in nonresidential new construction including Carlsbad, Contra Costa County, Palo Alto and Santa Cruz. Installing a complete electrical circuit, including wiring and circuit breakers, will achieve better economies of scale and avoid the overhead and time needed to hire an electrician. This includes the need for tenants to get approvals from building owner for an electrical wiring retrofit (for the residential sector, condo owners would typically need approval from the homeowners association).

In addition, many EVSE installation tasks can be completed during new construction at much lower cost than retrofitting later, such as:

- Retrofitting concrete pads for pedestals if needed to mount EVSE (and any associated payment kiosks) and/or bollards if needed, including concrete cutting, excavation, and repair;
- Mounting brackets for EVSE installed on walls or pillars;
- Any conduit or infrastructure needed to provide data for EVSE that are networked;
- Accessibility, as discussed further below in the Good Design Practices section;
- Soft costs such as customer (or customer representative) and contractor project management; project planning including design, engineering, and permitting; contractor mobilization; and any additional retrofit tasks needed for EVSE installations;
- Lighting, if required and not already installed on-site;
- Additional site-specific, real-world contingencies.

Installing a complete circuit with an EVSE installed will reduce burdens on local building officials and thus will tend to increase code compliance. Inspectors can more easily verify that a complete circuit is installed and operating correctly with an EVSE installed, rather than determining the specific electrical components that would be required for EV capable spaces.

Good Design Practices

Several local jurisdictions have adopted building codes that require good design practices to facilitate compliance with accessibility requirements for buildings subject to the CalGreen requirements, California

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[24] http://businessportal.ca.gov/wp-content/uploads/2019/07/GoBIZ-EVCharging-Guidebook.pdf

Code of Regulations Title 24, Part 2, Chapter 11B Section 11B-812. Section 11B-812 requires that a facility providing Electric Vehicle Charging Stations (EVCS), i.e. a parking spaces with an EVSE installed, for public and common use also provide one or more accessible EVCS, as specified in Table 11B-228.3.2.1. Chapter 11B applies to certain facilities including, but not limited to, public accommodations and publicly-funded housing (see Part 2, Section 1.9 of the California Building Code). It does not require review prior to construction of whether a building is designed to allow compliance with these requirements, and local codes require good design practices to fill this gap.

These local codes typically require that projects subject to the California Code of Regulations Title 24, Part 2, Chapter 11B, document how many accessible EVCS would be required as per Title 24, Chapter 11B to convert all required EV capable or EV ready parking spaces to EVCS. They also typically require that the builder demonstrate that the facility is designed such that compliance with accessibility standards, including Chapter 11B accessible routes, will be feasible for the required accessible EVCS at the time of EVCS installation.[25]

We note that retrofitting spaces that were not designed to facilitate compliance with accessibility requirements can be very expensive. For instance, this study finds that removing and repairing about 100 to 300 linear feet of surface parking that add conduit to non-accessible parking spaces for a small or medium facility can cost $11,500 to $32,000 in demolition and repair costs. While the scope of work for accessibility retrofits may be different from the conduit installation task, this information indicates that the types of costs required for accessibility retrofits (absent good design practices) may be similarly significant and in retrofit contexts may be cost prohibitive, space prohibitive, or both.

Methodology

The methodology for this report is similar to prior 2016 reports for the City of Oakland (with funding from the City of Oakland and grant funding from the California Energy Commission), and for the City and County of San Francisco (with funding from Pacific Gas & Electric and in-kind support from the City and County of San Francisco).[26] [27]

The cost analysis model that breaks each scenario and number of EV capable parking spaces into individual tasks and quantities, as shown in Appendix C. The model also contains estimates for the costs of each job task. Estimates of retrofit and new construction costs per job task are largely based on RS Means, a construction cost reference handbook for residential and nonresidential hardware and related installation

[25] For instance, section 11B-812 requires that “Parking spaces, access aisles and vehicular routes serving them shall provide a vertical clearance of 98 inches (2489 mm) minimum.” It also requires that parking spaces and access aisles meet maximum slope requirements of 1 unit vertical in 48 units horizontal (2.083 percent slope) in any direction at the time of new building construction or renovation. Section 11B-812.5 contains accessible route requirements. In addition, Title 24 Part 11 Section 4.106.4.2 requires that developers meet certain aspects of accessibility requirements at the time of new construction for a limited number of parking spaces.

[26] Pike, Ed and Steuben, Jeff. “Plug-In Electric Vehicle Infrastructure, Cost-Effectiveness Report.” 2016; and Pike, Ed, Jeffrey Steuben , and Evan Kamei. 2016. "Plug-In Electric Vehicle Infrastructure Cost-Effectiveness Report for San Francisco.”

[27] Pike, Ed, Jeffrey Steuben , and Evan Kamei. 2016. "Plug-In Electric Vehicle Infrastructure Cost-Effectiveness Report for San Francisco."

costs.[28] Additional costs for contractor labor, permits, architectural drawings, plans, site and/or load studies (for retrofit projects), inspections, and local permit and inspection fees are based on the resources listed in Appendix B and C. Additional information used to model these costs includes feedback from industry and utility experts, engineering estimates, and direct experience. For additional details on the methodology and information specific to the EV capable parking space details, please see Appendix C and Appendix D.

The cost analysis model includes hypothetical installation scenarios to compare costs between different numbers of EV capable parking space for new construction and retrofit projects. Actual project costs and configurations will vary; these cases are intended to provide representative examples for comparison purposes rather than to estimate site-specific costs. The model excludes project-specific costs outside the scope of EV capable parking space building code compliance such as acquisition and installation of the EVSE, signage, lighting, pedestal mounts, bollards, wheel stops, any required accessibility retrofit, and any other factors outside of CALGreen EV capable parking spaces requirements.[29] (Codes that address accessibility during alterations and additions such as the City of Fremont, City of Oakland, and City and County of San Francisco local codes can result in significant cost savings compared to changing these design parameters later as part of a stand-alone retrofit project. [30])

Recent editions to this model have added secondary transformers costs and electrical room costs (switchgear). The model still excludes utility-side infrastructure, such as concrete transformer pads, utility service connections, and associated demolition, to accommodate potential swap-out for a larger capacity primary transformer. Additional information on those costs can be found in the Table 7 of the Transformers section below.

Furthermore, the scenarios do not include sub-metering or separate metering equipment, which are optional, but could be selected by a building owner to access a special electricity rate.[31] Primary model costs are based on the City of Sacramento with a correction for PCE and SVCE's service area based on an average of San Jose and San Mateo's labor and material costs for the first quarter of 2019.

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28 For additional information, see www.rsmeans.com.

29 RS Means specifies a range of potential design costs, while noting that design costs will likely be 50 percent higher for alterations. We note that wheel stops may cost $150-$200 each and bollards may cost $500-$750 each based on input from an installer and RS Means costs for equipment types similar to bollards.

30 San Francisco Green Building Code 2016: http://library.amlegal.com/nxt/gateway.dll/California/sfbuilding/greenbuildingcode2016edition?f=templates$fn=default.htm$3.0$vid=amlegal:sanfrancisco_ca$anc=JD_GreenBuilding

31 A sub-meter may be a desirable add-on for some building owners or PEV drivers to allocate electricity costs and/or provide access to utility PEV charging electricity tariffs, though some special electricity rates for PEV owners are available through whole-house rates and utilities are also conducting pilots of metering via electric vehicle service equipment. The authors believe that builders wishing to install a socket for a sub-meter at the time of new construction may achieve cost savings compared to retrofits but have not quantified this potential.

4. Distribution Transformer Study

One important distinction in transformer classifications is between primary transformers (which are owned and operated by the utility) and secondary "step-down" transformers (which are owned and operated by a building owner). The main distinguishing factor between these is the overall building load and the particular utility rules which specify trigger points for the electrical design. For most situations, small buildings utilize shared distribution primary transformers split between multiple electrical accounts; medium-sized buildings feature a dedicated utility-owned primary transformer; and large buildings may feature a dedicated utility-owned primary transformer along with secondary transformer(s) depending on the electrical design of the building.

Primary Transformers (utility-owned, often with customer costs)

Primary transformers are needed to convert medium voltage utility distribution lines (normally 12kV) to customer level power at either 480V/277V for large buildings or 208V/120V or 240V/120V for medium buildings (for the purposes of this report, small buildings are on a shared transformer). Primary transformers are owned and operated by the utility but costs are partially split with the building owner. The costs borne by the utility operate with a ceiling, insulating utilities from the ballooning costs of the upgrades, allowing any excess above to be charged to the customer. This mechanism is known as an "allowance," effectively a budget for infrastructure upgrades funded through the electric rates. For PG&E, it is governed by Electric Rule 2[32], Electric Rule 15[33] & Electric Rule 16[34] which together lay out the rules for expanding service, extending distribution lines, and upgrading transformers. The allowance is dictated by these rules and based on historical electrical usage. The following excerpt is from Electric Rule 15:

$$\text{Allowance} = \frac{\text{Net Revenue}}{\text{Cost-of Service Factor}}$$

where the Cost of Service Factor is the annualized utility-financed Cost of Ownership as (N)
stated in Electric Rule 2. (N)

As written, these formulas and rule exceptions are complex because they apply for all electrical infrastructure situations, including agricultural, industrial, or rural contexts. However, generally-speaking, utility infrastructure upgrades have costs that are broken down between the building owner and the utility. For utility-owned transformers, the building owner will pay for the following nine elements:

1- a load study from the utility's service planning department,
2- trenching,
3- excavation
4- backfill,
5- compaction,
6- conduit,

32 https://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_2.pdf
33 https://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_15.pdf
34 https://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_16.pdf

7- substructures (boxes and pads),
8- pavings (cut, patch, and final repair), and
9- taxes and cost of ownership.

Meanwhile, the utility will pay (up to the allowance) for metering, wiring, and transformers. For any excess work required above the allowance, an advance is required by the customer, but can be converted to a monthly payment. If the revenue for the utility does not end up materializing in the first ten years, utilities have a mechanism to claw back funds called "deficiency billing."

The CPUC has been tracking service and distribution system upgrades for EV-projects from the three major California Investor-Owned Utilities, publishing their 7th annual report in April 2019[35]. The study indicates the relative frequency and magnitude of utility-side infrastructure costs that include both service upgrades and **primary** transformer upgrades. While this equipment is owned and operated by the utility, the customer will pay for upgrade costs until their allowance is exceeded.

In many cases this allowance is insufficient and costs can spread over to the customer in lump sum costs ahead of construction and/or higher monthly costs. The following table is pulled from the CPUC report and provides a high-level summary of these costs:

Table 10: Summary of Service Line and Distribution System Upgrades

	PG&E	SCE	SDG&E	Total
Residential Customers				
Estimated PEV customers through December 31, 2018	216,845	163,594	34,833	415,272
Residential Upgrades				
Number of PEV-related Infrastructure Checks Completed	10,138	Not tracked	Not tracked	N/A
Number of PEV-related Service Line and/or Distribution System Upgrades	323	243	52	618
Total Costs Incurred by Utility for Upgrades	$6,627,544	$351,675	$53,365	$7,032,584
Range of Costs for Upgrades	$14 to $338,274	$1 to $30,067	$47 to $10,958	N/A
Average Cost for Distribution System Upgrade	$19,262	$4,514	$4,089	N/A
Average Cost for Service Line Upgrade	$1,168	$1,382	$730	N/A
Number of Service Line Upgrades Exceeding Residential Allowance	39	33	0	72
Current Residential Allowance	$2,431	$3,084	$3,241	N/A
Amount of Foregone Billings to Customers for Service Line Upgrades Pursuant to "Common Facility Treatment" Policy Excemptiion for PEVs	$190,207	$37,887	$0	$228,094

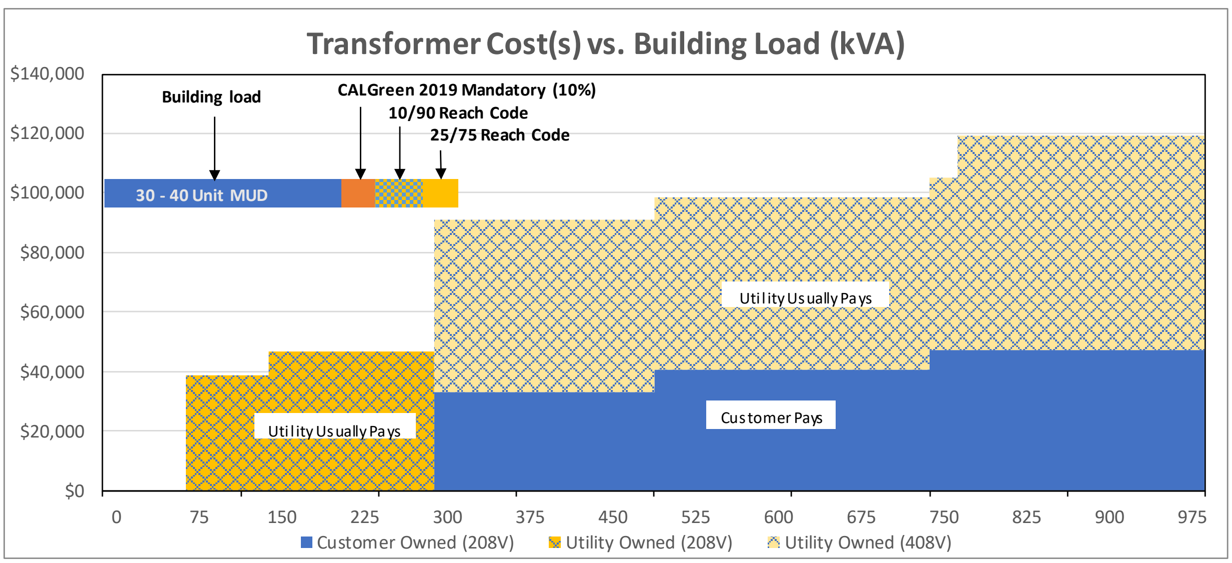
As shown above, PG&E's service territory indicates just over 3% (323 service line upgrades of 10,138 PEV-related Infrastructure Checks) of sites required distribution or service-line upgrades to accommodate EV infrastructure, demonstrating projects that exceed existing transformer capacity is not common yet. And of these less than 0.4% (39) exceeded the residential allowance resulting in additional costs to the building owner beyond the baseline upgrade costs. Two large caveats should be highlighted here. The first is that most of

[35] 7th Joint IOU Electric Vehicle Load Research Report: April 2019 (CPUC)

these early EV installations are residential customers and the second is that overall demand for charging infrastructure is increasing and it can be expected that more ports will be installed per parking lot than in the past. In addition, local jurisdictions may have local restrictions regarding placing transformers in public right of ways necessitating alternative siting such as placing transformers within the property line and under owner cost. The most important considerations are the "Range of Costs for Upgrades" ($14 - $338,274) and the "Average Cost for Distribution System Upgrade" ($19,262) which indicate both a very wide range between projects and the average magnitude for transformers upgrades in PG&E territory. It should be noted that the distribution upgrade costs across utilities are significant with PG&E ($19,262) incurring much higher costs than those of SCE ($4,514) and SDG&E ($4,089).

Secondary Transformers (customer-owned)

Secondary transformers are required from larger buildings based on the electrical service being provided by the utility. These rules are pre-determined by the utility's electric rules. In the context of this report, secondary transformers are those that convert 480V/277V power down to 208V/120V service. PG&E's Unit Cost Guide[36], PG&E's Greenbook[37], and RS Means were investigated to develop a characterization of electrical infrastructure costs (transformers) vs. building load (kVA). In the graph below, primary transformers costs are indicated in gold/yellow with blue-accented patterns[38] and secondary transformers costs are indicated in solid blue (costs associated with site preparation are not included). In addition to this, load estimates that were utilized for the cost effectiveness model are overlaid to provide a rough back-of-the-envelope load calculation for MUDs, to illustrate when certain costs become important in order to assist policy makers of the relative situations in which these triggers would occur:



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36 [PG&E Unit Cost Guide - April 2019]
37 2017-2018 PG&E Greenbook: Electric & Gas Service Requirements:(http://www.pge.com/greenbook)
38 The blue accent is to highlight that these costs often end up part of customer costs.

Figure 5: Costs of Transformers vs. Transformer system size (PG&E service territory)[39]

The figure above shows the magnitude of these transformer costs along with boundary points for small/medium and medium/large buildings utilizing rough estimates for number of units in a MUD with electric vehicle charging equivalent CALGreen 2019 mandatory levels. The sample number of MUDs shown in the figure above are meant to point out sizeable non-linear costs associated with transformer upgrades for this climate and this utility. In particular, attention should be paid to the 300kV load point which may cause considerable cost escalation as the electrical service would switch from 208V/120V to 480V/277V. As mentioned previously, this graphic is high-level, intended for policy makers and does not provide appropriate level of detail for a specific microclimate or a specific site.[40]

Transformer-sizing and other considerations

Electrical designers typically oversize transformers for future unspecified loads as "transformer headroom." A typical approach to transformer sizing is to obtain the calculated design load from the electrical schedule (building plan documents) and add 20% spare capacity for future load growth to be shown in the equipment schedule, unless otherwise directed by the facility based on design parameters[41]. Due to the large step-wise nature of transformers, it is possible that after accounting for headroom significantly more capacity is afforded. The table below illustrates this for the building models produced for this report:

Table 11. Transformer Sizing & Capacity

Building Type	60-Unit MUD		150-Unit MUD		60-Space Office Building
Baseline Building Load [kVA]	292		700		95
Baseline EV Load [kVA] (CALGreen 2019)	43		99		29
Capacity Requirement [kVA]	335 kVA		786 kVA		126 kVA
Capacity Requirement (with 20% headroom) [kVA]	402 kVA		944 kVA		152 kVA
Secondary Transformer Size [kVA]	500 kVA		1000 kVA		300 kVA
Overall Unused Capacity [kVA (% unused)]	165 kVA **(33%)**		214 kVA **(21%)**		174 kVA **(58%)**
Code Scenario	**Market Rate**	**Affordable Housing**	**Market Rate**	**Affordable Housing**	**10% L2 40% L1**
Additional Level 2 Ports	+12 L2	0	+22 L2	0	+2 L2
Additional Level 1 Ports	+45 L1	+54 L1	+113 L1	+135 L1	+24 L1
Additional EV Load [kVA]	+95 kVA	+54 kVA	+257 kVA	+156 kVA	+33 kVA
TOTAL EV Load [kVA]	430	389	1043	942	160

[39] This graph shows PG&E's specific equipment sizing and is not comparable to other utilities. Calculations are based on estimates from the infrastructure cost model.

[40] For example: Electrical system loading was developed by averaging climatic design data from Climate Zone 3 (Oakland) and 4 (San Jose) to develop a prototype HVAC system: (https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html)

[41] https://www.csemag.com/articles/selecting-sizing-transformers-for-commercial-buildings/

In the table above, the scenarios that are able to meet the EV reach codes with the existing headroom have been highlighted in green and the one scenario that would be unable to do so is highlighted in red. In most of these cases, the 20% headroom for the secondary transformer afforded significant flexibility to meet the reach codes. Transformers are sized for a worse-case scenario based on the requirements in the electrical code and very seldom operate near capacity. While it may be tempting to oversize a transformer above the typical industry headroom, significant oversizing should be cautioned because it can result in transformer operation significantly out of the normal efficient operation. As shown in Figure 6 below, load factor (percentage of total rated capacity) can have a significant influence on the transformer efficiency. In most times of the day, the transformer is operating at part load and oversizing a transformer can move performance out of the normal operating range and result in inefficient operation. The following figure shows a generalized transformer efficiency curve for a residential distribution transformer sized and highlights where a 20% load point might fall were the transformer pushed to the next size up, typically 40-55% increase in capacity.

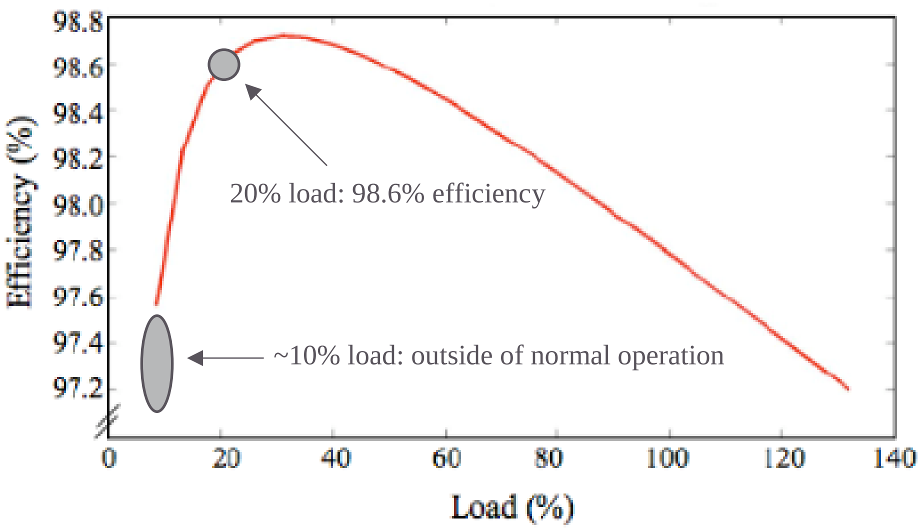

Figure 6: Transformer Efficiency vs. Load Factor[42]

The primary concern around transformers and associated costs pertain to the boundary cases where buildings close to the boundary of (1) needing to host a utility's dedicated primary transformer or (2) will require different utility service (480V instead of 208V) and need to modify their site to provide a secondary transformer. Approximate ranges of which MUDs would need to contend with this are noted in Figure 1 and Figure 5 above. If more capacity is required, it is likely that a combination of solar, energy efficiency measures, or adding battery storage would be able to prevent a transformer upgrades. On the other hand, the interest in electrification of existing gas appliances may compete for the existing capacity.

In the face of all this, load management is a promising option to allow more electric vehicle charging ports without needing to pay for larger infrastructure upgrades. This technology works by managing the amount of

[42]https://www.researchgate.net/publication/224598589_Challenges_of_PHEV_Penetration_to_the_Residential_Distribution_Network

throughput to individual charging ports based on what the control system defines for limitations. To date, this feature has primarily been marketed to limit electrical demand charges but could be utilized to prevent over-loading panels and/or transformers. Load management for electric vehicles is still nascent technology and would benefit with more developed industry standards. However, the National Electric Code has permitted power management since 2014 but industry may need training to create packaged solutions that can reassure plan checkers and building inspectors.[43]

[43] California Electrical Code (Title 24, Part 3): Article 750.30 – Load Management

Appendix A: Cost Estimates by Type of Expense

The following tables (Table 12 through Table 14) summarize model results for each type of expense per building. All costs below represent **incremental** costs compared to a baseline CALGreen 2019 mandatory building. See Appendix B and Appendix C for more details on the individual tasks included in each of the categories below. The per parking space costs are calculated by dividing the total incremental cost of by the number of added EV capable parking spaces. So for example, for the 60-unit MUD scenario shown below, a CALGreen 2019 mandatory baseline model was created to size the electrical use of a 60-unit MUD apartment building including electrical infrastructure associated with switchgear, panels, and secondary transformer. Under the new construction scenario, the additional 54 EV ports were added to the load and the system resized along with conduits added. For the retrofit scenario, the costs to upsize infrastructure, demolish structures, and provide raceways were added. NOTE: This study does not include costs for EVSE, and does not include and has a overall 20% contingency to account for ADA compliance. ADA can be a significant source of cost and in this study is only intended to capture a limited scope of ADA compliance.

Labor costs generally range from half to two-thirds of total project costs. Labor costs for small buildings with two EV capable parking spaces, based on current CALGreen six percent requirements, were estimated at about four fifths of the total project costs in new construction; however, this may not be representative of other projects for this building type with different site-specific circumstances.

Table 12. Estimated Incremental Cost of Installing EV Infrastructure: 60-Unit MUD

	60-Unit MUD			
Retrofit	Market Rate [NC]	Market Rate [Retrofit]	Affordable Housing [NC]	Affordable Housing [Retrofit]
Level 2 Ports Added	9	9	0	0
Level 1 Ports Added	45	45	54	54
Electrical panel	$15,960	$26,008	$9,289	$13,004
Main electrical room, excluding transformer	$13,609	$43,911	$14,055	$35,193
Transformer (480V -> 208V)	$14,164	$12,743	$1,081	$10,897
Raceway / In-slab conduit	$18,059	$77,247	$18,059	$77,247
Electrical components (wire, receptacle)	$11,366	$20,131	$11,307	$20,049
Trenching for installation of conduit	$0	$0	$0	$0
Demolition of equipment	$0	$31,940	$0	$30,918
Pavings (asphalt & concrete)	$0	$7,889	$0	$7,889
Permitting & inspection fees	$2,435	$15,592	$2,435	$15,592
Construction management	$549	$4,449	$403	$4,264
TOTAL	$76,142	$239,909	$56,629	$215,051
TOTAL (Price per Port)	$1,410	$4,443	$1,049	$3,982

Table 13. Estimated Incremental Cost of Installing EV Infrastructure: 150-Unit MUD

	150-Unit MUD			
Retrofit	Market Rate [NC]	Market Rate [Retrofit]	Affordable Housing [NC]	Affordable Housing [Retrofit]
Level 2 Ports Added	23	23	0	0
Level 1 Ports Added	112	112	135	135
Electrical panel	$59,785	$83,699	$44,926	$62,896
Main electrical room, excluding transformer	$10,059	$49,276	$10,059	$49,276
Transformer (480V -> 208V)	$11,539	$49,742	$0	$40,621
Raceway / In-slab conduit	$45,147	$193,116	$45,147	$193,116
Electrical components (wire, receptacle)	$28,062	$49,833	$28,407	$50,317
Trenching for installation of conduit	$0	$0	$0	$0
Demolition of equipment	$0	$79,850	$0	$77,294
Pavings (asphalt & concrete)	$0	$8,442	$0	$8,442
Permitting & inspection fees	$5,798	$33,069	$5,798	$33,069
Construction management	$1,159	$6,655	$964	$5,196
TOTAL	$161,550	$553,682	$135,301	$520,227
TOTAL (Price per Port)	$1,197	$4,101	$1,002	$3,854

Table 14. Estimated Incremental Cost of Installing EV Infrastructure: 60-Space Office

	60-Space Office	
Retrofit	Offce [NC]	Office [Retrofit]
Level 2 Ports Added	2	2
Level 1 Ports Added	24	24
Electrical panel	$5,571	$13,004
Main electrical room, excluding transformer	$8,558	$35,005
Transformer (480V -> 208V)	$5,748	$7,786
Raceway / In-slab conduit	$0	$0
Electrical components (wire, receptacle)	$5,285	$9,031
Trenching for installation of conduit	$5,133	$4,562
Demolition of equipment	$0	$6,211
Pavings (asphalt & concrete)	$0	$6,305
Permitting & inspection fees	$4,448	$11,652
Construction management	$227	$3,414
TOTAL	$34,971	$96,970
TOTAL (Price per Port)	$1,166	$3,232

Appendix B: Permitting and Inspection Costs

Table 15 shows examples of permitting and inspection fees. These fees are not calculated in the model per project but as inputs based on the closest representative level for a project. Table 16 shows the details for these calculations based on the City and County of San Francisco and costs may vary by region.

Table 15. Examples of Total Permit and Inspection Cost Summary

	Stand-alone Retrofit			New Construction (Incremental Costs)		
# of Circuits	**Fee**	**Builder Staff Time**	**Total**	**Fee**	**Builder Staff Time**	**Total**
2	$461	$650	$1,111	$27	$75	$102
4	$1,365	$850	$2,215	$164	$125	$289

Table 16. Electrical and Building Permit and Inspection Cost Data

Electrical and Building Permit and Inspection Cost Data				
Electrical				
Fees				
$335	Minimum inspection fee, which covers from 1 to 3 inspections			
$11	Estimated average application fee per additional circuit beyond minimum			
Builder Time Costs				
New Construction, alterations &	Stand-alone Retrofit			
$25	$100	Builder staff time to obtain new permit (inclusive of travel)		
$25	$100	Builder staff time per inspection (inclusive of travel)		
$0	$150	Electrical engineer staff time for load calculations		
Building				
Fees				
New Construction, alterations, additions		*Stand-alone retrofit*		
Plan	Permitting	Plan	Permitting	
-	-	$ 144.85	$ 62.08	up to $500
-	-	$ 2.93	$ 1.26	per hundred from $500 up to $2000
-	-	$ 1.78	$ 0.76	per hundred from $2000 up to $50,000
$ 0.19	$ 0.10	-	-	per hundred from $5,000,000 to $50m
source: San Francisco Fee Table 1A-A				*note: only costs used in model are listed*
Builder Time Costs				
Incremental Cost, New	Retrofit			
$25	$100	Builder staff time to obtain new permit		
$0	$100	Builder staff time per inspection (inclusive of travel)		

Notes:

- Fees are calculated based on San Francisco Fee Table 1A-A (building) and Table 1A-E (electrical). New construction fees are based on the incremental cost of adding EV charging infrastructure to a project.
- Two building inspections are assumed for small retrofits, and no additional building inspections are assumed for new construction. One electrical inspection is assumed for adding two circuits and three are assumed for adding 12 circuits.

Appendix C: Methodology Details

This appendix provides additional details on the general assumptions used in the models, data sources for per unit equipment and other costs, and the methods used to determine the quantities needed for each expense type. This appendix does not contain data specific to the scenarios that were modeled, but rather a more general overview of the cost model.

General Assumptions

- Cost estimates include a fixed general overhead and profit factor.[44]
- Labor costs and equipment costs are based on cost estimates from RSMeans 2019 Q1 and utilize standard union rates.
- RSMeans cost data specified Sacramento, CA with a geographic correction which averaged the RS Means City Cost Index of San Mateo and San Jose.
- In some cases, RS Means contains minimum retrofit task costs.[45] Where related tasks had separate minimum task costs but the labor crew could likely perform more than one related task, the model applied one minimum labor charge.
- Building electrical infrastructure was sized utilizing W/ft^2 engineering calculations for lighting, air conditioning, and other major appliances.
- Building area was estimated using US Census Data
- Common area is assumed for Laundry usage
- Air Conditioner sizing was calculated based on California Climate Zone data for Zone 3 and Zone 4
- California CEUS[46] data is utilized to determine demand for offices

Data Sources

Estimates of per unit equipment and installation costs were based on retrofit and new construction costs from RS Means, a construction cost reference handbook and online tool for hardware and related installation costs. The City and County of San Francisco rates were used for permit and inspection fee sheets; and the authors estimated costs for contractor labor for permitting, inspections, site inspection, and architectural plans. Cost data from RS Means was for 2018 and was scaled to 2019 using U.S. Bureau of Labor Statistics Producer Price Index statistics. Additional data sources include: feedback from industry experts, engineering estimates, and direct experience to capture different tasks required for the scenarios that were analyzed. This appendix contains a list of all tasks included in the analysis.

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[44] Individual RS Means line items related to overhead (under General Requirements) are assumed to be addressed by overhead and profit.
[45] Minimum task costs are typically not relevant for new construction due to the overall project scale.
[46] http://capabilities.itron.com/CeusWeb/ChartsSF/Default2.aspx

Soft Costs

Permit and Inspection Fees

Permitting costs for breaking concrete and electrical permit fees are based on available information from the City and County of San Francisco fees.[47] The total estimated costs include rough and final building and electrical permit fees where applicable. The cost for adding EV capable spaces during construction of a new building is assumed to be relatively low. Builder time spent towards permit filing and inspections is included at $100 per hour spent on site. Permit and inspection costs can vary between regions.

The model includes a small amount of labor to accommodate permitting and inspection of elements specific to EV capable parking spaces in new construction and alterations and additions, since these activities are already required and minimal additional effort should be needed to add EV capable infrastructure.

Since economies of scale occur with larger quantities, these fees generally scale up with increasing quantities of EV capable infrastructure, though they are not completely scalable. Costs are higher for outdoor circuits than for indoor circuits due to trenching and are higher for retrofits than for new construction or alterations and additions due to demolition, repaving, and repairs.[48]

ARCHITECTURAL PLAN FEES

Costs to add EV capable parking spaces to architectural plans and drawings will vary between projects based on their overall complexity. They are based on the estimated number of hours for each project and a fee of $150/hour before geographic adjustments. Costs will also vary if the project is new construction or a retrofit. In the former case, costs will be relatively minor because the architectural firm will likely be familiar with the plan of the building and can easily influence relevant design decisions like adding EV capable infrastructure. For retrofit projects, costs will likely be significantly higher due to the need to investigate and accommodate more complex on-site conditions such as: longer conduit runs, demolition and reconstruction, meeting accessibility requirements based on existing conditions, and/or more limited options for electrical room and panel placement.

A minimal incremental cost is required for adding several EV capable parking spaces to a new building or alteration and addition. In contrast, preparing construction plans for large numbers of EV capable parking spaces to an existing building may take a significant amount of time considering the layout and construction details for each parking space and existing site conditions. Costs will partially scale by the number of EV capable parking spaces.

LOAD STUDY/SITE CONDITIONS STUDY

Additional expenses are required for stand-alone retrofits at medium or large buildings to assess existing load and other conditions. The load study is necessary to determine the current electrical supply capacity, such as

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[47] See Table 1A-A and Table 1A-E

[48] We note that efforts are underway to streamline permitting and inspections of EV charging infrastructure including EV capable parking spaces.

the transformer and other systems related to the main electrical supply and the current actual load.[49] The study will then determine which on-site upgrades may be needed to install EV capable parking spaces. In addition, site-specific conditions may need to be determined such as current concrete conditions, soils conditions, and/or other conditions. A load study at a facility where other site condition studies aren't needed is assumed to cost $1,000. Factors such as demolition and/or a greater number of EV parking spaces will drive costs up and a more complex study is assumed to cost $5,000 in this report (prior to prime contractor expenses). X-ray costs are roughly $1,000 for a half dozen images, which may be enough for retrofit installations at a medium sized facility, however, more may be required for a 150-space garage.[50] A specific site may require more or less resources depending on actual conditions.

Assuming alterations and additions originally intended for non-EV charging purposes will require an assessment of load and existing conditions, the assessment would also suffice for EV charging as well.

ELECTRICAL PANEL LOCATIONS AND SIZING

Some electrical panels are located in the main electrical room while others are distributed closer to EV parking spaces to reduce branch circuit lengths and costs. Distributed panels are more practical in locations with convenient wall mounting locations protected from weather and vandalism. All panel and sub-panel conduits are assumed to be installed in 1 ½ inch steel surface-mounted conduits for 225 ampere panels (to carry 250 MCM wire) or 2-inch conduits for 400 ampere panels (to carry 600 MCM wire) to provide a high level of protection and allow for easy visual inspection.

In some cases, a panel installed in new construction can be upsized to serve both base loads (such as garage lighting, elevators, and miscellaneous outlets) and EV charging loads. In other cases, panels for EV charging are sized to their maximum practical size (typically 400 amperes) just to meet EV charging needs. (Panels are generally limited by electrical panel capacity rather than physical size for EV electrical infrastructure. A single-phase 400-ampere panel has electrical capacity for 10 circuits and typically has physical space for 15 40-amperes circuits even if they utilize double slot 20-ampere breakers.)

The type of electrical panels will depend on whether a building is served by three-phase (4-wire) electrical service or one-phase (3-wire) electrical service. Medium and large commercial buildings and multifamily buildings usually receive three-phase service. When a panel receives three phases of electricity instead of one, it can accommodate additional EV capable parking spaces. However, the phases must be "balanced", which restricts how many additional circuits for EV capable parking spaces can be accommodated. We assumed that three-phase 225 ampere panels can accommodate 9 40-amp circuits and three-phase 400 ampere panels can accommodate 15 40 ampere circuits based on interviews with contractors and an electrical design firm.

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[49] Transformers are usually sized based on the typical maximum actual load of a building. Unlike electrical panels and electrical circuits, transformers can be under loaded to extend their lifetime of fully loading, or even occasionally overloaded without causing an immediate reliability issue but with potential reduced long-term lifetime.
[50] Concrete X- Ray Imaging, Penhall, https://www.penhall.com/concrete-x-ray-imaging/ accessed 7-4-2019.

Construction Management

The model also includes a cost factor to represent additional fixed costs incurred by contractors for retrofit installations prior to project initiation. These costs include contractor time spent traveling to a site for surveying, evaluating existing conditions, estimating project costs, and preparing bids. Costs will vary based on the complexity of the project.[51] For new construction, these costs likely do not apply or require minimal additional effort to address EV capable electrical infrastructure. The construction management category also includes general permit application fees.

Raceways, Wire, and Termination Point

PVC materials (i.e. plastic) are included for branch circuit conduits installed in new construction of enclosed parking areas and alterations and additions to enclosed parking that remove the parking surface, while wall and ceiling-mounted metal conduit is assumed for stand-alone retrofits. The authors assumed that intermediate metal conduit was installed for any outdoor raceway in trenches to provide corrosion resistance and for any indoor retrofit cases where walls and floors will not be replaced. Additional raceways may be needed between floors and inaccessible areas.

1¼-inch raceways are generally assumed to carry up to twelve #8 wires rated at 40 amperes (three per circuit) to support 30-ampere EVSE, with the potential to add wiring for a fifth circuit where convenient.[52,53] Some additional raceways are also needed to serve individual termination locations (i.e. a main conduit run carrying four wires may end at one receptacle pair and a local distribution conduit would carry the other pair to its termination point). These short distribution raceways were also sized at one and a quarter inches for simplicity; though they could be sized at one inch or below, we do not expect that this difference would be significant. In some cases, raceways installed in-slab during new construction will accommodate more and/or higher capacity wires than retrofits that are wall mounted and encounter additional bends at corners and obstacles, limiting their capacity. These potential cost savings are site-specific and not included in the model. Wire is not included for branch circuits for EV capable parking spaces. Wires for any distributed panels that are noted in the scenario summary table are included in the costs.

The length of raceways within a given floor for enclosed parking at new construction and repaving are calculated based on direct routes from the electrical panel to the termination point since no obstacles are present during new construction. Retrofitting surface-mounted conduit is generally assumed to be twice as long in new construction because they must follow walls and ceilings with less direct routing. Compared to new construction, raceway distances are increased by 125 percent for gut rehabilitation because significant

[51] This estimate assumes that contractors win some of their bids for retrofit projects. The success rate will vary based on specific circumstances. For instance, a sole source contacting mechanism would result in a higher success rate while a contracting mechanism requiring three or more bids would result in a lower success rate. Actual costs will vary from project to project.

[52] Because EV charging is consider a continuous load, the circuit capacity must be at least 25 percent higher than the end load.

[53] We note that higher capacity #6 wire could also be installed at a rate of four sets per 1 ¼ inch conduit without larger sized conduit, unless conduit capacity is limited due to bends that restrict fill rates. For an example of allowable fill rates, see Elliot Electric Supply “Conduit Fill Table” at https://www.elliottelectric.com/StaticPages/ElectricalReferences/ElectricalTables/Conduit_Fill_Table.aspx.

portions of the building are removed while some obstructions may remain. Raceway distances are also increased by 150 percent for stand-alone retrofits in outdoor trenches to account for indirect routing (i.e. avoiding existing infrastructure). Surface mounted retrofit distances are increased by 200 percent, compared to new construction, due to the long distances to follow existing walls and to account for routing around existing obstacles.

Actual configurations can vary based on site-specific circumstances. For instance, if several EV parking spaces are located a significant distance from the main electrical panel, a single (larger) raceway run to an additional electrical panel closer to EV parking spaces can be installed with raceways branching from the panel to the planned EVSE location. This configuration would most likely save costs in buildings where the reduced length of raceways would exceed additional electric panel costs. Raceways for electrical panels outside of the main electrical room are sized (at ½ inch intervals, i.e. 1 ½ inch or 2 inches) based on the wire needed to serve that panel.

Conduits will generally terminate at a receptacle with an outlet box with a face plate and no EVSE (i.e. the unit that connects to the vehicle) installed at the time of construction. Local municipal building codes can also require a specific type of receptacle, which does not have a large impact on the cost-effectiveness of code. Receptacles are assumed to be installed in pairs to serve parking spaces on either side of the pair.

No additional curbs or bollards are assumed at the termination point. Local jurisdictions may wish to include a requirement for anchor points for EVSE near the termination point if the EVSE can be wall-mounted, which should not significantly affect the cost of EV capable building codes.

Demolition, Reconstruction, and Repaving

The model contains several job types related to demolition, construction, and repaving for stand-alone projects and projects where parking areas and/or electrical rooms are undergoing renovations that would allow installation of this equipment without any further demolition and reconstruction.

For both enclosed and surface parking, demolition for electrical rooms includes cutting and/or drilling, breaking large pieces into smaller pieces, minimum equipment/labor costs, loading and disposal. Reconstruction costs include concrete work (cost for pouring slabs is used as a proxy), reinforcing rods, forms, and minimum labor charges.

Demolition for parking areas include cutting a three-foot-wide section of pavement to allow two-foot-wide trenches; backhoe rental to trench, mobilization and operation, and disposal of materials. Some trenching would also be required for adding EV capable parking spaces in new construction, when repaving existing parking or adding parking. In these cases, costs would likely be much lower due to the presence of trenching equipment on-site to meet other project needs unrelated to EV capable parking spaces.

Contingencies

A 20 percent contingency was applied for stand-alone retrofit projects based on RS Means. Contingencies are necessary because specific challenges may not be visible at the start of a stand-alone retrofit project or because existing conditions may be difficult to alter without expanding the scope and cost of a retrofit project - for instance if an electrical room lacks space for additional panel(s) or was originally constructed far from parking spaces. A general contingency was not added for EV capable parking spaces installed as part of a larger retrofit project such as resurfacing or building new parking spaces at an existing site because the conditions will more closely resemble new construction, given their broader scope. In addition, specific cost increases were already included to address higher costs for alterations and additions compared to new construction, such as conservatively assuming that additional parking spaces would be located further from electrical power than existing spaces.

On top of this, another 20 percent contingency was applied to estimate potential costs for accessibility (ADA) compliance associated with restriping, adjusting path of travel, vertical clearances, and slope modifications. ADA compliance costs can be significant but are not the focus of this report.

Transformers

Transformer costs related to secondary or "step down" transformers have been incorporated into this cost model. Only the wiring costs are considered, not the additional costs for a concrete pad, or disposal of the previous transformer. As mentioned previously, these transformers are used to "step down" 480 V service to 208/240 V for buildings connected to 480 V power, which in PG&E's service area consist of buildings in the 300kVA and up range. CARB has found that EV charging generally represents a relatively small fraction of overall building power demand in multifamily housing with 10% EV Capable parking spaces. These transformer upgrades are often not necessary to support EV charging infrastructure for buildings but may be more likely with the higher EV infrastructure requirements such as those considered in this report.

An electrical engineering firm and several contractors were consulted with and confirmed that they have found that levels of EV capable parking spaces proposed for CALGreen typically would not require a transformer upgrade, noting the typical headroom of 20% is usually sufficient to cover this growth. It was noted that in some cases, a potential off-site utility infrastructure upgrade could be required, as noted in the Primary Transformers section above.

In the case that EV infrastructure would trigger an expensive switchgear or transformer upgrade it should be investigated whether retrofits that include more energy-efficient lighting and other equipment meeting current mandatory California, ENERGY STAR®, and/or federal standards.

We expect that in cases where a transformer upgrade would be required to install EV capable infrastructure, building codes requiring EV capable parking spaces and associated electrical capacity could achieve significant cost savings related to these costs. Stand-alone transformer retrofits could require replacing conduits serving the transformer, replacing the transformer pad or adding a new pad, and adding an additional transformer or upgrading an existing transformer. By comparison, designing the electrical room for adequate capacity would allow the installation of larger sized conduits and/or transformer pads during initial construction at minimal cost. While we have not quantified all of these costs, the incremental cost of installing a 3" conduit instead of a 2" conduit would be very small compared to breaking existing concrete to install a larger sized conduit later.

Task Descriptions

Task descriptions for each scenario are listed below in Table 17. The table lists tasks with a note to designate where the task applies to retrofits, new construction, or both. A negative number indicates the avoidance of smaller electrical panel(s) due to installation of a larger panel. (Tasks that are listed with a “0” quantity were included as an option in detailed calculations used to determine project task descriptions, but the detailed design calculations resulted in a zero quantity for the specific task).

Table 17. Task Descriptions and Quantities

Task Description	Construction Type	Work Type	Unit	60-unit MUD			150-unit MUD			Medium Office	
				CALGreen	Market Rate	Affordable Housing	CalGreen	Market Rate	Affordable Housing	CalGreen	10% L2 40% L1
				Quantity for Each Scenario							
Rent core drill, electric, 2.5 H.P. 1" to 8" bit diameter, includes hourly operating cost	retro	demo	ea.		8	10		20	25		4
Rent mixer power mortar & concrete gas 6 CF, 18 HP, one day including 4 hours operating cost	retro	demo	Ea.		2	2		5	5		
Rent backhoe-loader 40 to 45 HP 5/8 CY capacity, one day including 4 hours operating cost	retro	demo	per day								3
Selective demolition, rubbish handling, dumpster, 6 C.Y., 2 ton capacity, weekly rental, includes one dump per week, cost to be added to demolition cost.	retro	demo	Week		2	2		5	5		0
Deconstruction of concrete, floors, concrete slab on grade, plain, 4" thick, up to 2 stories, excludes handling, packaging or disposal costs	retro	demo	S.F.		24	30		60	75		
Selective concrete demolition, reinforce less than 1% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping	retro	demo	C.Y.		8	10		20	25		5
Selective concrete demolition, minimum labor/equipment charge	retro	demo	Job		2	2		5	5		
Concrete sawing, concrete slabs, rod reinforced, up to 3" deep	retro	demo	L.F.		24	30		60	75		16
Concrete sawing, concrete, existing slab, rod reinforced, for each additional inch of depth over 3"	retro	demo	L.F.		24	30		60	75		16
Selective demolition, concrete slab cutting/sawing, minimum labor/equipment charge	retro	demo	Job		2	2		5	5		1
Concrete core drilling, core, reinforced concrete slab, 2" diameter, up to 6" thick slab, includes bit, layout and set up	retro	demo	Ea.		60	60		150	150		
Receptacle devices, residential, duplex outlet, ivory, EMT & wire, 20', 15 amp, incl box & cover plate	new	electric	Ea.		27	23		68	56		12

Task Description	Construction Type	Work Type	Unit	60-unit MUD			150-unit MUD			Medium Office	
				CALGreen	Market Rate	Affordable Housing	CalGreen	Market Rate	Affordable Housing	CalGreen	10% L2 40% L1
				Quantity for Each Scenario							
Receptacle, range, 50 Amp	retro	electric	Ea.		6	15		15	38		6
Receptacle devices, residential, duplex outlet, ivory, EMT & wire, 20', 15 amp, incl box & cover plate	retro	electric	Ea.		27	23		68	56		12
permitting & inspection, 2 internal circuits, excludes general building permit fees	new	fee	per job								
permitting & inspection, 4 internal and 2 external circuits, excludes general building permit fees	new	fee	per job							1	5
permitting & inspection, 4 internal circuits, excludes general building permit fees	new	fee	per job	1							
permitting & inspection, 14 internal circuits, excludes general building permit fees	new	fee	per job		1	1	1	1	1	1	1
permitting, per internal circuit over 4, excluding general buildling permit fees	new	fee	per ciruit	2	20	20	1	60	60	2	
permitting & inspection, 14 internal and 7 external circuits, excludes general building permit fees	retro	fee	per job				1	1	1		
permitting & inspection, 14 internal circuits, excludes general building permit fees	retro	fee	per job		1	1					1
permitting, per internal circuit over 4, excluding general buildling permit fees	retro	fee	per circuit		20	20		60	60		20
architectural plans/drawings	retro	fee	per hour	8	14	14	14	38	38	6	9
architectural plans/drawings	new	fee	per hour	2	4	4	4	12	12	2	3
site and load study	retro	fee	per $1000	1	3	3	3	5	5	1	2
Circuit Breakers - 480V 3-pole, 70 to 225Amp	new	main	Ea.	1	-1	-1					
Circuit Breakers - 480V 3-pole, 70 to 225Amp	retro	main	Ea.	1							
Switchboard - 3-pole, 4-wire, 400 Amp	retro	main	Ea.	1						1	
Circuit Breakers - 480V 3-pole, 450 to 600 Amp	retro	main	Ea.		1		1				
Circuit Breakers - 480V 3-pole, 700 to 800 Amp	new	main	Ea.			1					
Circuit Breakers - 480V 3-pole, 700 to 800 Amp	retro	main	Ea.			1					
Circuit Breakers - 480V 3-pole, 125 to 400Amp	new	main	Ea.								1
Circuit Breakers - 480V 3-pole, 125 to 400Amp	retro	main	Ea.								1
Circuit Breakers - 480V 3-pole, 15 - 60 Amp	retro	main	Ea.							1	
Distribution Switchboard Enclosure - 4 wire, 1000 Amp	new	main	Ea.					1	1		
Distribution Switchboard Enclosure - 4 wire, 1000 Amp	retro	main	Ea.					1	1		
Incoming Switchboards - 277/480V, 4 wire, 800 Amp	retro	main	Ea.			1					1
Incoming Switchboards - 277/480V, 4 wire, 800 Amp (w/ Fused Switch & CT Compartment)	new	main	Ea.					1	1		

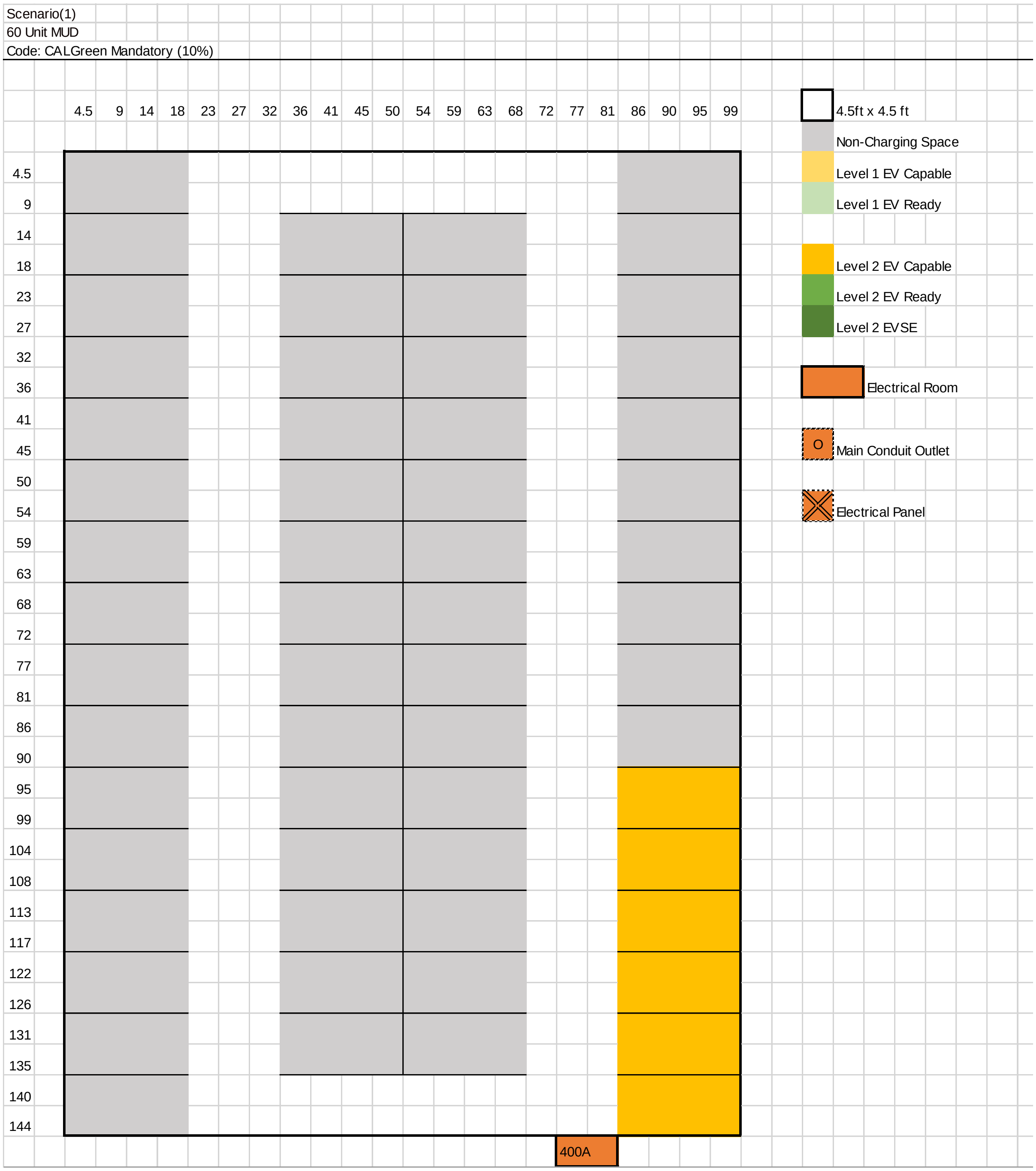
ATTACHMENT 6

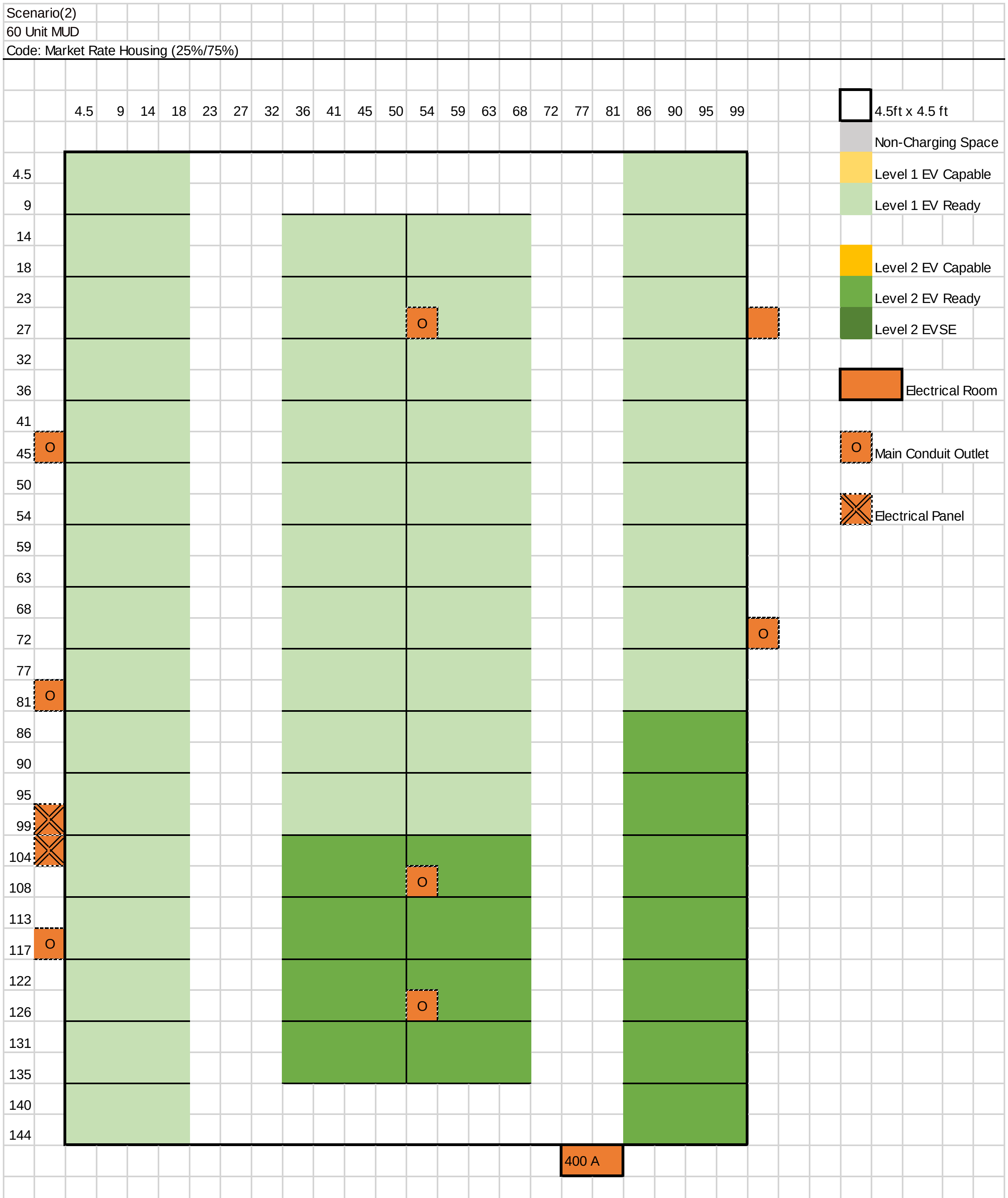
Task Description	Construction Type	Work Type	Unit	60-unit MUD			150-unit MUD			Medium Office	
				CALGreen	Market Rate	Affordable Housing	CalGreen	Market Rate	Affordable Housing	CalGreen	10% L2 40% L1
				Quantity for Each Scenario							
Incoming Switchboards - 277/480V, 4 wire, 800 Amp (w/ Fused Switch & CT Compartment)	retro	main	Ea.					1	1		
Switchboard - 3-pole, 4-wire, 2000 Amp	new	main	Ea.					1	1		
Switchboard - 3-pole, 4-wire, 2000 Amp	retro	main	Ea.					1	1		
Switchboard - 3-pole, 4-wire, 600 Amp	retro	main	Ea.		1		1				
Switchboard - 3-pole, 4-wire, 800 Amp	new	main	Ea.			1					1
Switchboard - 3-pole, 4-wire, 800 Amp	retro	main	Ea.			1					1
Panelboards, 1 phase 3 wire, main circuit breaker, 120/240 V, 225 amp, 30 circuits, NQOD, incl 20 A 1 pole bolt-on breakers	new	panel						1		1	-1
Panelboards, 1 phase 3 wire, main circuit breaker, 120/240 V, 225 amp, 30 circuits, NQOD, incl 20 A 1 pole bolt-on breakers	retro	panel						1			
Panelboards, 1 phase 3 wire, main circuit breaker, 120/240 V, 400 amp, 30 circuits, NQOD, incl 20 A 1 pole bolt-on breakers	new	panel		1	1	-1			1		
Panelboards, 1 phase 3 wire, main circuit breaker, 120/240 V, 400 amp, 30 circuits, NQOD, incl 20 A 1 pole bolt-on breakers	retro	panel			1	2			1		1
Reinforcing steel, in place, dowels, smooth, 12" long, 1/4" or 3/8" diameter, A615, grade 60	retro	pave	Ea.		90	90		72	72		48
Structural concrete, in place, slab on grade (3000 psi), 4" thick, includes concrete (Portland cement Type I), placing and textured finish, excludes forms and reinforcing	retro	pave	S.F.		30	30		24	24		16
Structural concrete, in place, minimum labor/equipment charge	retro	pave	Job		1	1		1	1		1
PVC conduit, schedule 40, 1-1/4" diameter, in concrete slab, includes terminations, fittings and supports	new	race	L.F.	324	2147	2147	1080	5366	5366		
LV Transformer, Dry Type - 480V primary, 120/208V secondary (112.5 kVA)	retro	trans	Ea.		1						
LV Transformer, Dry Type - 480V primary, 120/208V secondary (75 kVA)	Retro	trans	Ea.								1
LV Transformer, Dry Type - 480V primary, 120/208V secondary (150 kVA)	Retro	trans	Ea.			1				1	
LV Transformer, Dry Type - 480V primary, 120/208V secondary (225kVA)	Retro	trans	Ea.	1							
LV Transformer, Dry Type - 480V primary, 120/208V secondary (300 kVA)	New	trans	Ea.		1						
LV Transformer, Dry Type - 480V primary, 120/208V secondary (500 kVA)	New	trans	Ea.			1					

Task Description	Construction Type	Work Type	Unit	60-unit MUD			150-unit MUD			Medium Office	
				CALGreen	Market Rate	Affordable Housing	CalGreen	Market Rate	Affordable Housing	CalGreen	10% L2 40% L1
				Quantity for Each Scenario							
LV Transformer, Dry Type - 480V primary, 120/208V secondary (500 kVA)	Retro	trans	Ea.					1			
LV Transformer, Dry Type - 480V primary, 120/208V secondary (750 kVA)	Retro	trans	Ea.				2		1		

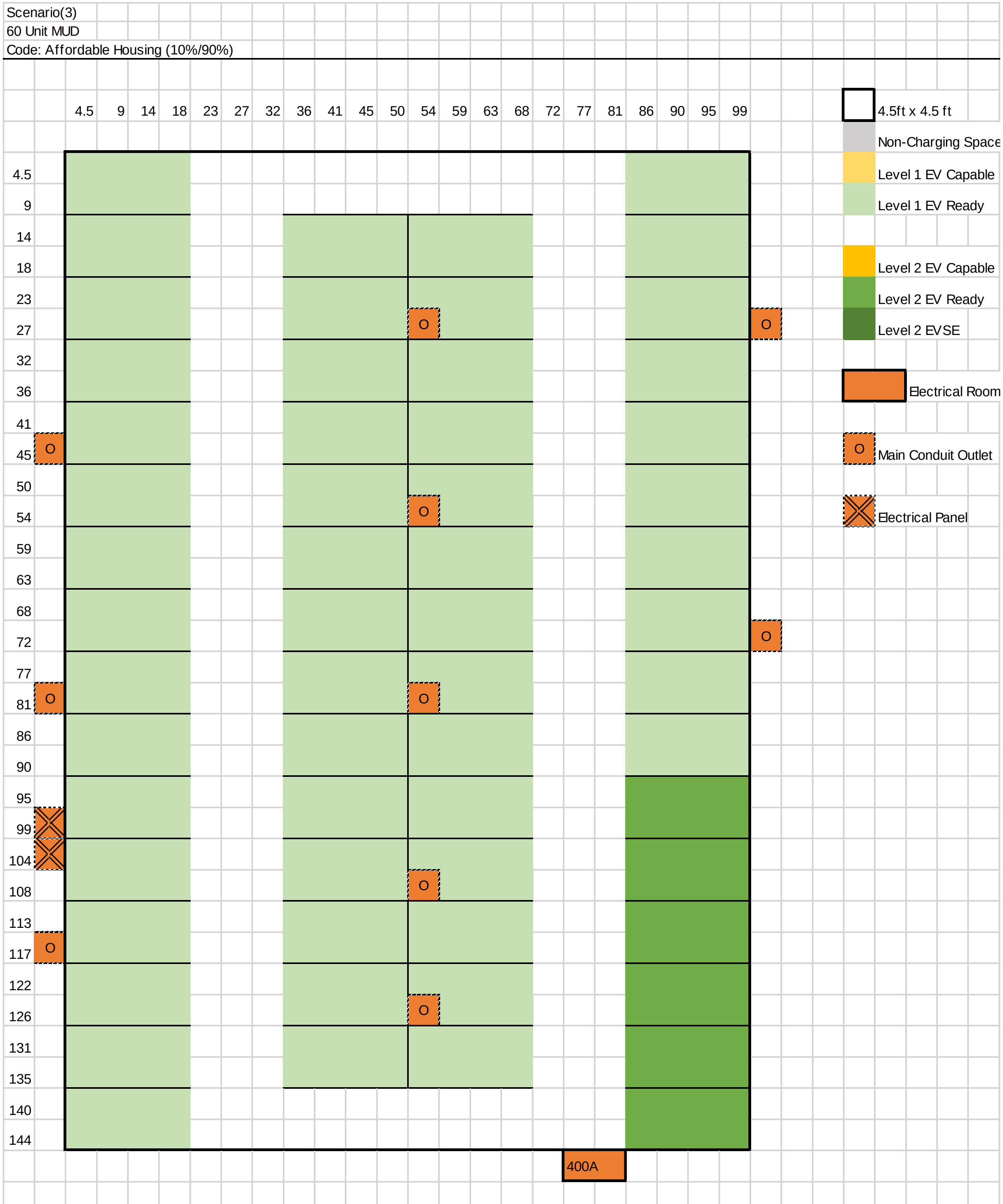
Appendix D: EV Capable Installation Configurations

This section includes figures to generally depict the configuration of each scenario that was analyzed. They are not intended to include all details of a particular installation nor are they intended to represent any particular specific installation.

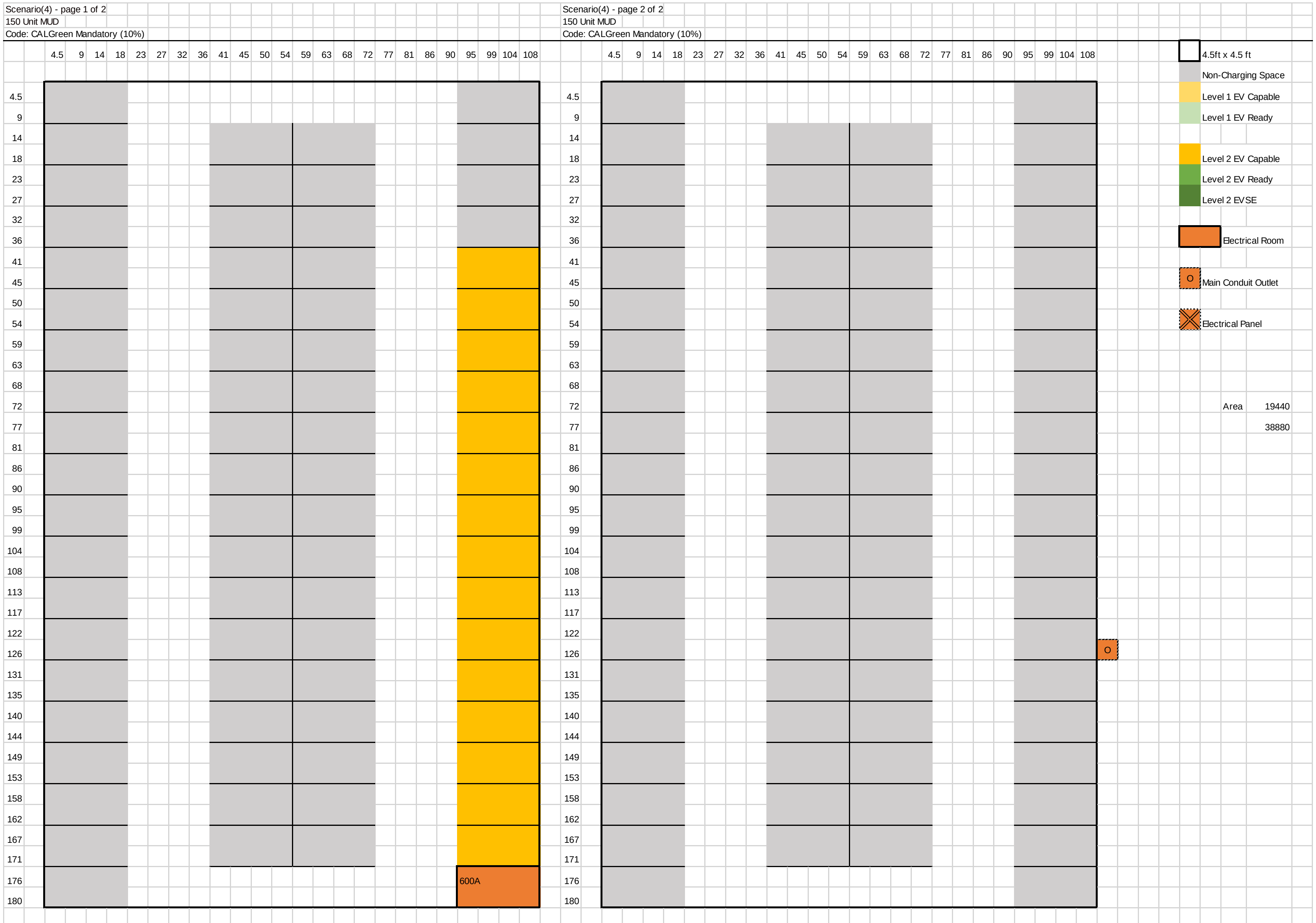


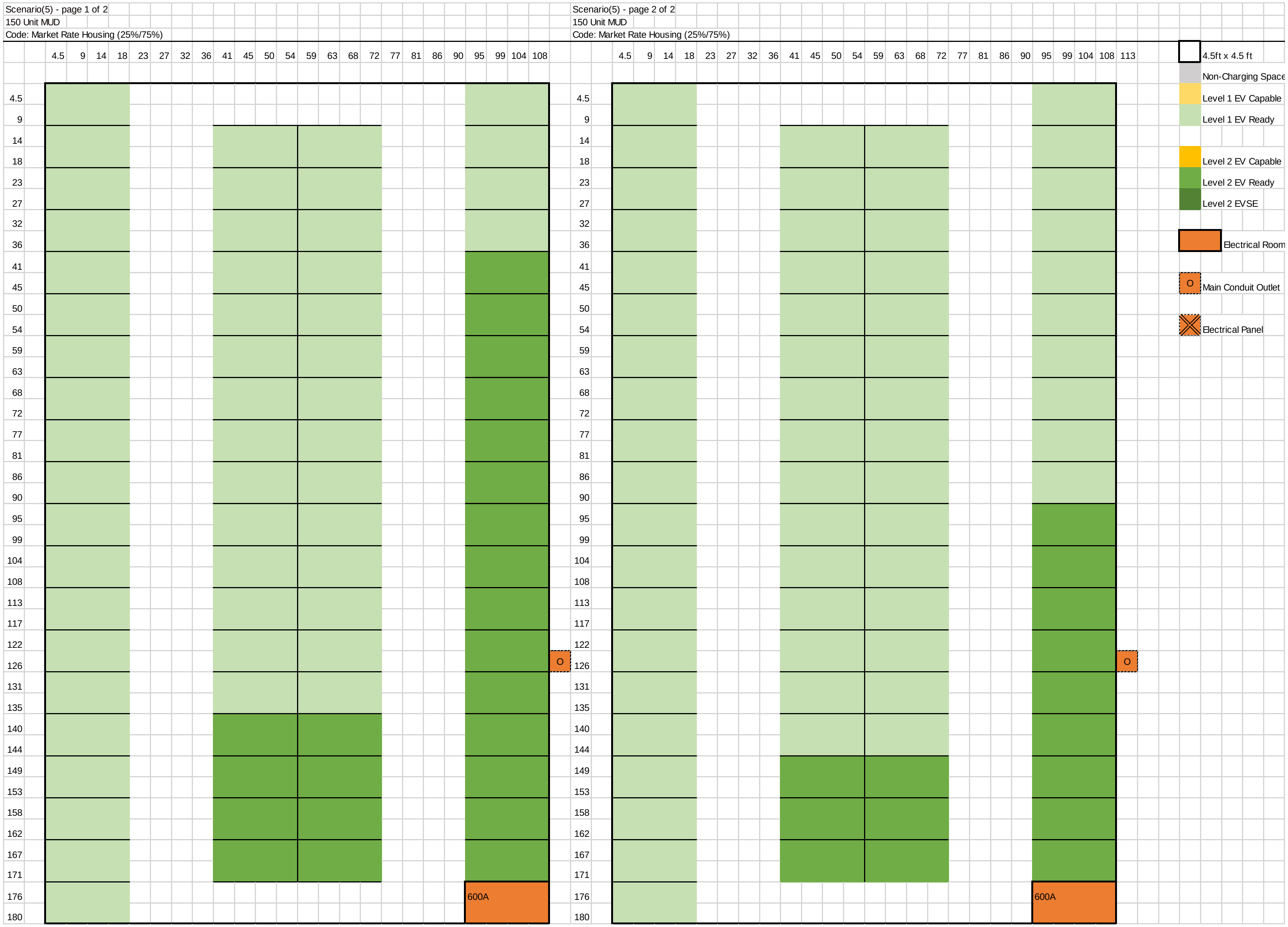

Scenario(2)
60 Unit MUD
Code: Market Rate Housing (25%/75%)
4.5 9 14 18 23 27 32 36 41 45 50 54 59 63 68 72 77 81 86 90 95 99
4.5 9 14 18 23 27 32 36 41 45 50 54 59 63 68 72 77 81 86 90 95 99 104 108 113 117 122 126 131 135 140 144
400 A
4.5ft x 4.5 ft
Non-Charging Space
Level 1 EV Capable
Level 1 EV Ready
Level 2 EV Capable
Level 2 EV Ready
Level 2 EVSE
Electrical Room
Main Conduit Outlet
Electrical Panel

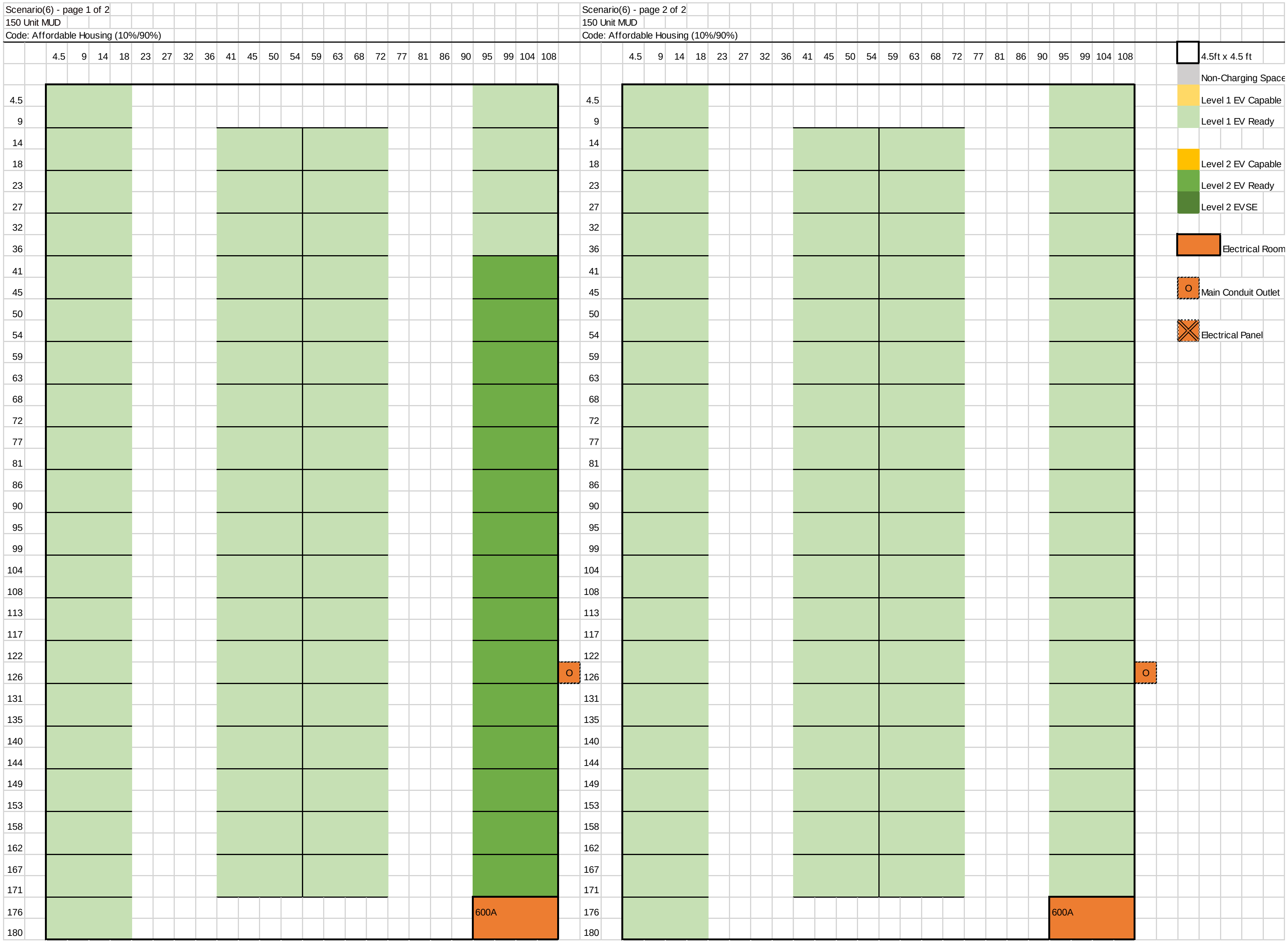
ATTACHMENT 6



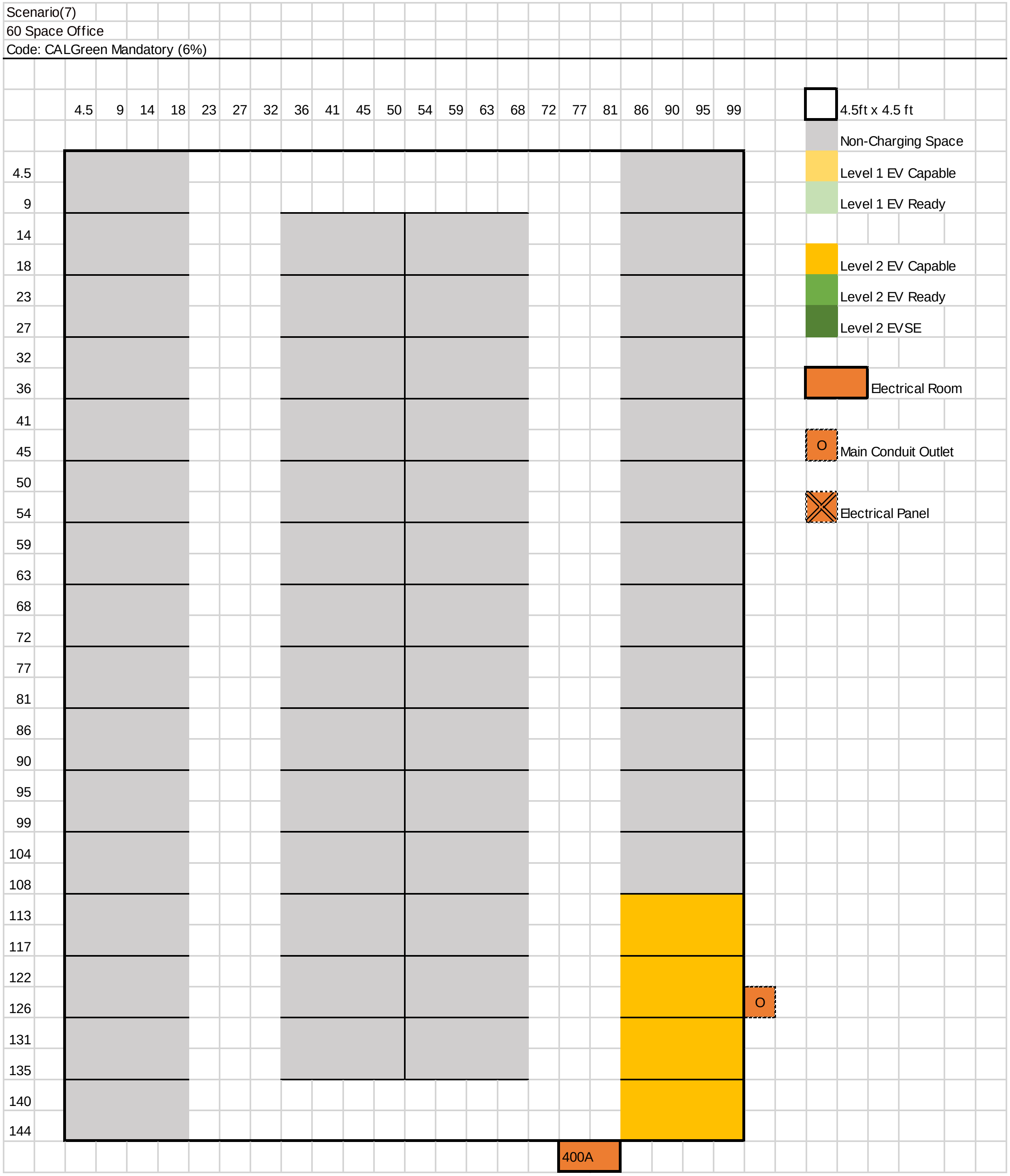
ATTACHMENT 6

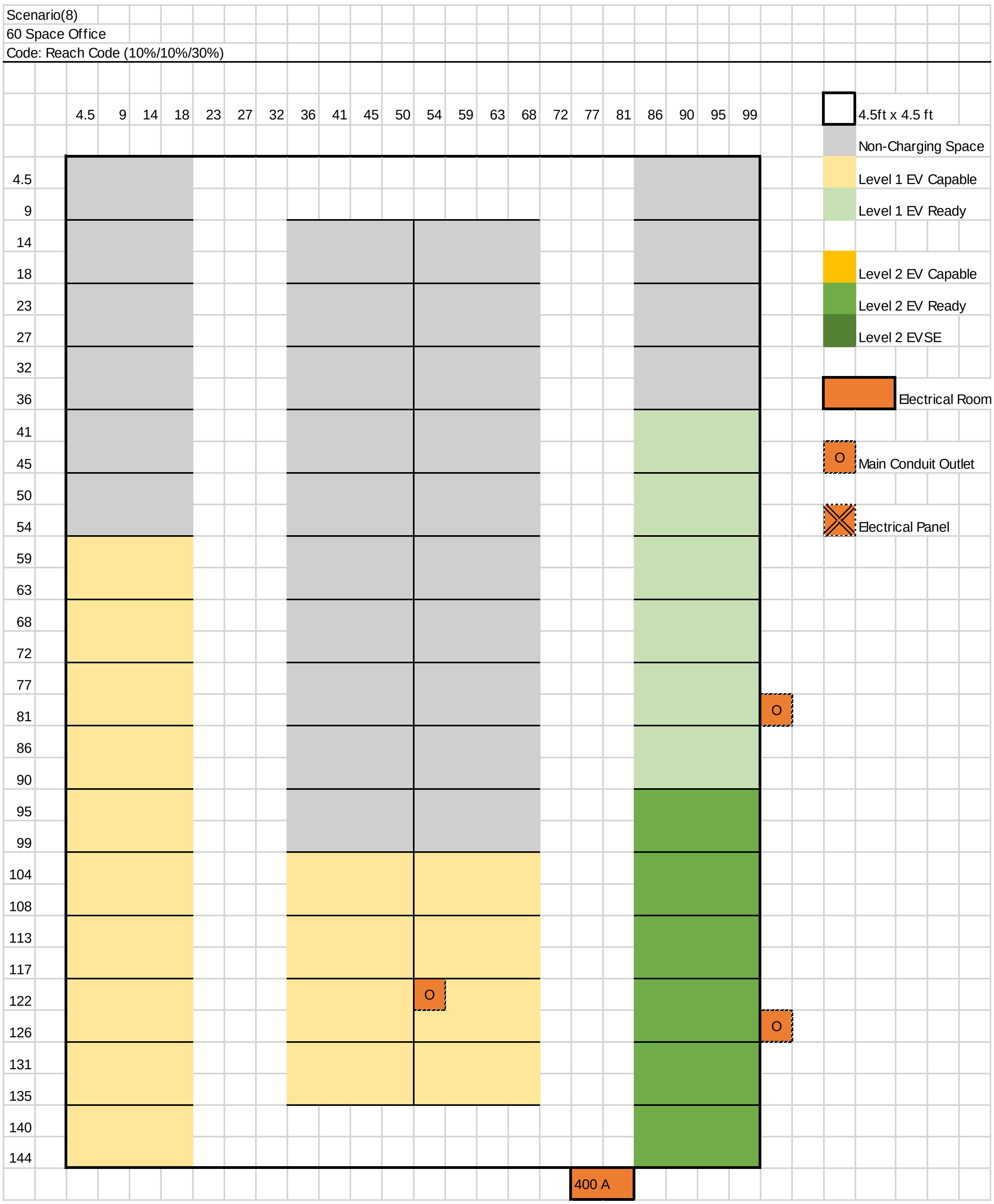



Scenario(5) - page 1 of 2
150 Unit MUD
Code: Market Rate Housing (25%/75%)
Scenario(5) - page 2 of 2
150 Unit MUD
Code: Market Rate Housing (25%/75%)
600A
O
600A
O
4.5ft x 4.5 ft
Non-Charging Space
Level 1 EV Capable
Level 1 EV Ready
Level 2 EV Capable
Level 2 EV Ready
Level 2 EVSE
Electrical Room
Main Conduit Outlet
Electrical Panel


Scenario(6) - page 1 of 2
150 Unit MUD
Code: Affordable Housing (10%/90%)
600A
O
Scenario(6) - page 2 of 2
150 Unit MUD
Code: Affordable Housing (10%/90%)
600A
O
4.5ft x 4.5 ft
Non-Charging Space
Level 1 EV Capable
Level 1 EV Ready
Level 2 EV Capable
Level 2 EV Ready
Level 2 EVSE
Electrical Room
Main Conduit Outlet
Electrical Panel

ATTACHMENT 6




Scenario(8)
60 Space Office
Code: Reach Code (10%/10%/30%)
4.5 9 14 18 23 27 32 36 41 45 50 54 59 63 68 72 77 81 86 90 95 99
4.5 9 14 18 23 27 32 36 41 45 50 54 59 63 68 72 77 81 86 90 95 99 104 108 113 117 122 126 131 135 140 144
4.5ft x 4.5 ft
Non-Charging Space
Level 1 EV Capable
Level 1 EV Ready
Level 2 EV Capable
Level 2 EV Ready
Level 2 EVSE
Electrical Room
O
Main Conduit Outlet
Electrical Panel
O
O
O
400 A

Silicon Valley Clean Energy (SVCE) Community Reach Code Adoption Chart ATTACHMENT 11

					Building Reach			EV Reach
Member Agency	Status	Next Meeting	Date of Next Meeting	Code Language	Encourage Gas Reduction (1 + 2 + 2A)	Limit Gas (1 + 2A)	Ban Gas (1 only)	Higher than CalGREEN
Mountain View		Approved		Begins on pg. 23			X	X
Morgan Hill		Approved		Begins on pg. 45			X	
Milpitas		Approved		Begins on pg. 1132	X			X
Monte Sereno		Approved		Begins on pg. 3	X[1]			X
Saratoga		Approved		Begins on pg. 33		X		X
Los Gatos		Approved		Begins on pg. 93			X	X
Cupertino		Approved		Ordinance			X	X
Los Altos Hills		Approved		Ordinance		X		X
Campbell		Approved		Begins on pg. 41		X		
Los Altos		1st Reading					X	
Santa Clara County		Staff Proposal			X			
Sunnyvale		Staff Proposal				X		
Gilroy	-	Declined						

[1]Reach code proposes wiring all homes for electric appliances and battery storage

Key

Status

- 🍃🍃🍃🍃🍃 Approved
- 🍃🍃🍃🍃 2nd Reading
- 🍃🍃🍃 1st Reading
- 🍃🍃 Staff Proposal
- 🍃 Council Briefing

Building Reach

1 - All-electric buildings
2 - Mixed fuel has higher requirements
2A - Mostly electric/electric heating only

Pacific Gas and Electric Company

Robert S. Kenney
Vice President
State and Regulatory Affairs

P. O. Box 77000
San Francisco, CA 94177-00001
Mail Code B23A
(415) 973-2500
Robert.Kenney@pge.com

June 23, 2020

California Energy Commission
Docket Unit, MS-4
Re: Docket No. 19-BSTD-03
1516 Ninth Street
Sacramento, California 95814-5512

Pacific Gas and Electric Company (PG&E) is proud to provide electric and natural gas service to our customers. And we are committed to helping customers and the community achieve their energy goals. As part of this commitment, PG&E welcomes the opportunity to support the California Energy Commission's efforts to advance efficient, all-electric new construction, when it is feasible and cost-effective, through the forthcoming rulemaking for the 2022 iteration of California's Energy Code (Title 24, Part 6).

PG&E strongly supports California's climate and clean air goals. We recognize that achieving these goals require a range of approaches and tools, including increasing the use of energy-efficient electric appliances in buildings when cost-effective. PG&E welcomes the opportunity to avoid investments in new gas assets that might later prove underutilized as local governments and the state work together to realize long-term decarbonization objectives. With all this in mind, PG&E supports state and local government policies that promote all-electric new construction when it is feasible and cost-effective. PG&E supports and encourages investment in the supporting code compliance and enforcement tools and resources that will be needed to implement the evolving requirements in the forthcoming 2022 Energy Code.

Beyond new construction, PG&E believes a multi-faceted approach is needed to cost-effectively achieve California's broader economy-wide long-term GHG reduction objectives, including both electrification and decarbonizing the gas system with renewable natural gas and hydrogen. As California's decarbonization policies evolve, PG&E will continue to ensure the safe and reliable operation of the electric and gas systems to continue supporting the customers that depend on us.

PG&E appreciates the opportunity to comment and support the Energy Commission during its triennial rulemaking process, including through our role as statewide leads for the Codes & Standards program. Participating in the rulemaking process, and utilizing the time between code adoption and the effective date, allows us to prepare for the future and continue providing the best service possible to customers. PG&E continuously forecasts load in its service territory and implements upgrades to the distribution grid to meet the demand. PG&E fully expects to meet the needs that all-electric buildings will require. PG&E remains ready to engage with our customers, local government, businesses, and community members to meet their needs safely, reliably, affordably, and with clean energy.

PG&E looks forward to continuing to work with the California Energy Commission to accomplish its policy goals.

Thank you, and have a safe day.

Sincerely,

Robert S. Kenney
Vice President

cc: Mark Krausse

From:	Chris Jordan
To:	Emiko Ancheta; Jon Biggs; Andrea Chelemengos
Subject:	FW: Reach Codes
Date:	Thursday, October 22, 2020 3:47:43 PM

From: Lauren Weston [redacted]
Sent: Thursday, October 22, 2020 3:08 PM
To: City Council <council@losaltosca.gov>
Subject: Reach Codes

Honorable Mayor Pepper and City Council Members,

I am writing to thank you for considering Electric Reach Codes for new construction. I urge you to move forward quickly to adopt a Reach Code requiring All-Electric for new homes and buildings. Preventing the use of fossil fuels, including natural gas, in new construction will create more affordable, cleaner, healthier, and more resilient housing and buildings for communities throughout Los Altos.

Adopting Reach Codes is the single biggest climate action that the city can take this year. Reach Codes enable all-electric heating and appliances that make our homes and buildings safer, healthier, and more affordable, as well as helping us meet our climate action plan goals. It will also future proof our city against expensive and uncertain supplies of natural gas.

Following the lead of 16 area cities – such as Mountain View, Cupertino, and Redwood City - which have recently adopted All-Electric Reach Codes, would maximize the benefits for our city, including:

1. Saving money – **All-electric homes save an average $10,000 in construction costs.**
2. Improving health and safety by avoiding indoor pollution and highly flammable combustion sources inside our homes & buildings.
3. Making a highly visible and practical step forward to address the climate crisis, by breaking the cycle of fossil fuel dependency in buildings. **Each new electric home saves up to 4 tons of carbon per year.**

The reach code will be a strong market signal to spur development of more carbon free, electric solutions for *existing* homes. I hope you will **adopt a strong Reach Code that avoids gas use with all-electric requirements. This is an urgently needed climate action to phase out fossil natural gas fuel use in our homes and buildings!** Let's work together towards a fossil free and climate-stable future.

Thanks,
Lauren Weston, Executive Director, Acterra (530.219.2813)

ADDITIONAL INFORMATION ON HEALTH RISKS OF NATURAL GAS ENERGY USE IN RESIDENTIAL BUILDINGS

Major gas leaks and explosions like those in San Bruno, Aliso Canyon, and in Western Massachusetts make the news, highlighting the precarious state of our natural gas infrastructure. However, natural gas pipeline explosions and incidents are quite common, causing 15 fatalities, 57 injuries, and over $300 million in property damage each year in the US. And the National Fire Protection Association found that natural gas use in homes is responsible for almost half of the residential house fires, causing numerous injuries and deaths each year.

Further, natural gas leaks are a pervasive problem with gas infrastructure. This can be particularly hazardous for people living in earthquake and fire-prone areas like ours, since leaking gas leads to fires after earthquakes. The California Seismic Safety Commission estimates that 20 to 50 percent of total post-earthquake fires are caused by gas leaks.

Burning of gas in household appliances produces harmful indoor air pollution, including nitrogen dioxide, carbon monoxide, formaldehyde, acetaldehyde, and ultrafine particles. The carbon monoxide produced by burning gas indoors can be lethal without proper venting. According to U.S. EPA, carbon monoxide poisoning results in roughly 15,000 emergency room visits and 500 deaths every year.

Gas stoves produce so much nitrogen dioxide that the levels of air pollution (*aka smog*) inside many kitchens, would violate federal air quality standards if measured outside. The California Air Resources Board warns that cooking emissions from gas stoves, have been associated with increased respiratory disease. Young children and people with asthma are especially vulnerable to indoor air pollution caused by open flame appliances and other appliances that le

October 23, 2020

Los Altos City Council
1 North San Antonio Road
Los Altos, CA 94022

Regarding: Item 7, October 27, 2020 City Council Agenda – Support

Dear Los Altos City Council:

The American Institute of Architects Silicon Valley and American Institute of Architects California support Item 7 on the October 27th City Council Agenda regarding the adoption of an electrification reach code.

Now is the time to insist that future buildings are designed to be more energy efficient and to be ready for renewable energy sources.

We support the adoption of an all-electric energy code for residential and commercial buildings. We support efforts by local governments to require new buildings in their jurisdictions to be all-electric before it becomes a state mandate. We believe the move to all-electric buildings must begin right away, that this is crucial to reducing carbon emissions and other pollutants, improving health outcomes, lowering energy costs, helping mitigate fire risk, and aiding California in meeting its legislated carbon reduction targets.

Indoor and outdoor air pollution disproportionately impact disadvantaged communities and communities of color, and, unfortunately, California continues to lead the nation in air pollution and its health impacts. These structural inequities must be addressed with urgency. Fossil fuel combustion in buildings release seven times more NOX pollution than do all of California's power plants

All-electric buildings of all types and sizes are already being designed today by AIA architects across the state. They use efficient electric appliances that run on California's rapidly expanding clean renewable energy supply supplemented with rooftop or community solar. We encourage the City of Los Altos to join the several dozen other communities in the State to show leadership in support of a truly equitable and sustainable future by requiring buildings to be all-electric.

Sincerely,

[redacted]

Keith Blaine, AIA
President, AIA Silicon Valley

[redacted]

Debra Gerod, FAIA
President, AIA California

PUBLIC HEARING

Agenda Item # 8

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Park In-Lieu Fee Update

Prepared by: Jim Sandoval, Engineering Services Director
Reviewed by: Sharif Etman, Administrative Services Director
Approved by: Chris Jordan, City Manager

Attachment(s):
1. *Appraisal Report, Unencumbered Residential Land, Los Altos, Santa Clara County, CA* (February 13, 2020)
2. Resolution No. 2020-35

Initiated by:
Staff

Previous Council Consideration:
April 8, 2014; April 22, 2014; May 27, 2014; January 8, 2019

Fiscal Impact:
Based on the attached February 13, 2020, independent real estate appraisal commissioned by the City, the fair market value of an acre of land available for purchase in the City of Los Altos is $10.78M ($247.50 per square foot). Staff used this appraisal to calculate an update to the existing Park In-Lieu fees from the current amount of $77.5K/household to $87.3K/household for single family/detached homes and from $48.8K/household to $55.0K/household for multi-family/attached homes. The proposed update will increase the two fees by 12.6% and 12.7%, respectively.

Currently, the Park In-Lieu Fee fund has $5.3M. Approximately $2M of it is budgeted to support approved projects in the 5-year CIP Budget. The remaining $3.3M is earmarked to fund the new Community Center. However, if the City is eligible to borrow more than the $10M it needs to fully fund the Community Center, then the $3.3M could be freed-up for other park-related projects.

Over the next several years the City is anticipating up to $19.8M in additional Park In-Lieu Fee revenue from pending multi-family residential development projects proposed for development. Table 1 below provides a breakdown of these pending projects.

Increasing the Park In-Lieu Fees in accordance with the appraisal's land value estimate would increase the anticipated $19.8M in fees by an additional $2.5M and yield approximately $22.3M over the next several years.

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	JH	SE

Subject: **Park In-Lieu Fee Update**

TABLE 1
Park In-Lieu Fees
Approved and Pending Multiple-Family Residential Projects: Updated August 24, 2020

Location	Status	CC Approval Date	Number of Units	Current 2019 In-Lieu Fee per Unit**	Pending Projects Anticipated Revenue	Approved Project Anticipated Revenue	Revenue Received	Payment Received Date
385-389 First St	Building Permit Submitted	7/9/2019	10	$ 48,800	$ 488,000	$ 488,000	TBD	TBD
425 First St	Building Permit Submitted	6/25/2019	20	$ 48,800	$ 976,000	$ 976,000	TBD	TBD
4898 El Camino Real	Approved	10/1/2019	28	$ 48,800	$ 1,366,400	$ 1,366,400	TBD	TBD
5150 El Camino Real	Approved	10/22/2019	196	$ 48,800	$ 9,564,800	$ 9,564,800	TBD	TBD
4856 El Camino Real	Approved	11/27/2018	50	$ 48,800	$ 2,440,000	$ 2,440,000	TBD	TBD
4350 El Camino Real	In Process	N/A	47	$ 48,800	$ 2,293,600	N/A	TBD	TBD
4896 El Camino Real	In Process	N/A	4	$ 48,800	$ 195,200	N/A	TBD	TBD
376 First St	In Process	N/A	15	$ 48,800	$ 732,000	N/A	TBD	TBD
440 First St	In Process	N/A	4	$ 48,800	$ 195,200	N/A	TBD	TBD
444-450 First St	Approved	3/10/2020	27	$ 48,800	$ 1,317,600	$ 1,317,600	TBD	TBD
140 Lyell Ave*	In Process	N/A	4	$ 48,800	$ 195,200	N/A	TBD	TBD
TOTAL			**405**		**$ 19,764,000**	**$ 16,152,800**	**$ -**	

Notes:
Table does not include projects that are already under construction.
**The project is five units, but is replacing an existing unit.*
***In-Lieu Fee reflects current value, not the proposed $55K/unit value.*

Environmental Review:
This action is exempt from environmental review pursuant to Section 15273(a)(4) of the State Guidelines implementing the California Environmental Quality Act of 1970, as amended, because it consists of modifying existing fees that are for the purpose of obtaining funds for capital projects, park and recreational improvements, necessary to maintain service within existing service areas.

Policy Question for Council Consideration:
- Does the Council wish to increase Park In-Lieu Fees to reflect current fair market value of land available for park purchase?

Summary:
- As a condition of approval of a final subdivision or parcel map, the subdivider shall dedicate land, pay a fee in-lieu thereof, or a combination of both at the option of the City, for park or recreational purposes.
- The fair market value of lands available for park purchase can be used to establish in-lieu fees, by formula, for both new single family and multi-family projects.
- Each fiscal year, the Engineering Services Director makes a determination on the City's current fee and whether it is commensurate with the fair market value of the lands available for park purchase or existing park lands.

Subject: **Park In-Lieu Fee Update**

Staff Recommendation:
Move to adopt Resolution No. 2020-35, modifying Park In-Lieu Fee on the FY 2020/21 Fee Schedule for the City of Los Altos.

Subject: **Park In-Lieu Fee Update**

Purpose

To increase Park In-Lieu Fees to reflect current fair market value of land to ensure that the fees will continue to generate sufficient funds to acquire land and construct the park and recreational facilities needed to serve new development.

Background

Park In-Lieu fees are authorized by the Quimby Act and allow cities to charge new residential development for community park land. The park land valuation calculation is based on state law parameters and formulas of three acres of park land per 1,000 residents, the value of real estate in Los Altos, and the number of residents per household. As a condition of approval of a final subdivision or parcel map, the subdivider shall dedicate land, pay a fee in-lieu thereof, or a combination of both at the option of the City, for park or recreational purposes, according to the provisions of Los Altos Municipal Code, Section 13.24.010.

Per the muni code, Park In-Lieu fees shall be used only for the purpose of providing park or recreational facilities reasonably related to serving the subdivision from which fees are collected. Fees so collected shall be used to purchase land or, if the City Council deems that there is sufficient land available for the subdivision, for improving such land for park and recreational purposes, buying equipment, or constructing improvements in neighborhood and district park and recreational facilities.

The Planning Commission shall, upon approving a tentative map, recommend the conditions necessary to comply with the requirements for park land dedication or fees in-lieu thereof as set forth in the muni code, and such conditions shall be attached as conditions of approval of the map. Park In-Lieu fees are calculated based on the following formulas for additional units on a subject property as set forth in Section 13.24.010(D) of the muni code:

<u>Single Family/Detached:</u>
3 acres/1,000 residents = 0.003 acres per resident
0.003 × 2.7 residents per household = 0.0081
0.0081 × one acre of land, or value thereof *(i.e., 0.0081 × appraised value [$] per acre)*

<u>Multiple Family/Attached:</u>
3 acres/1,000 residents = 0.003 acres per resident
0.003 × 1.7 residents per household = 0.0051
0.0051 × one acre of land, or value thereof *(i.e., 0.0081 × appraised value [$] per acre)*

Subject: **Park In-Lieu Fee Update**

Discussion/Analysis

Pursuant to Section 13.24.010(D) of the muni code, the Public Works Director (now the Engineering Services Director) shall make an annual determination of the fair market value of the lands available for park purchase or existing park lands.

Based on the attached February 13, 2020, independent real estate appraisal commissioned by the City, the fair market value of an acre of land available for purchase in the City of Los Altos is $10.78M ($247.50/square foot). Staff used this appraisal to calculate an update to the Park In-Lieu, as follows:

Single Family/Detached
3 acres/1,000 residents = 0.003 acres per resident
0.003 acres/resident x 2.7 residents per household = 0.0081 acres/household
0.0081 acres/household x $247.50/SF x 43,560 SF/acre = $87.3K/household

Multiple Family/Attached
3 acres/1,000 residents = 0.003 acres per resident
0.003 acres/resident x 1.7 residents per household = 0.0051 acres/household
0.0051 acres/household x $247.50/SF x 43,560 SF/acre = $55.0K/household

Based on a November 28, 2018, independent real estate appraisal, the existing Park In-Lieu fees are currently set at $77.5K for single family/detached homes and $48.8K for multi-family/attached homes. For reference and comparison, current park land dedication/in-lieu fees of some nearby local agencies were found to be as follows:

Local Cities	Single-Family	Multiple-Family
Cupertino	$105,000	$54K-$105K
Los Altos	$87,300	$55,000
Sunnyvale	$80,259	$52,533
Palo Alto	$66,487	$45,820
Mountain View[1]	$60,000	$20,000
Santa Clara	$39,882	$32,119
Saratoga	$32,343	$21,562
Campbell	$24,480	$17,370
Los Gatos[2]	$0	$0

1 Mountain View calculates Park In-Lieu Fees on a project by project basis, typically resulting in fees established in the range of $20,000-$60,000 per unit.

2 Los Gatos does not charge a park land dedication fee to new development because the Town already has more park land than is required under the Quimby Act.

In addition to the Park In-Lieu Fee, new residential development in the City is also required to pay a Traffic Impact Fee (LAMC Chapter 3.48), an Affordable Housing Impact Fee (LAMC Chapter 3.49) and a Public Art Funding Fee (LAMC Chapter 3.52).

Options

1) Option #1 - Move to adopt Resolution No. 2020-35, modifying the Park In-Lieu Fees on the FY 2020/21 City of Los Altos Fee Schedule from the existing amount of $77.5K/household to $87.3K/household for single family/detached homes and from $48.8K/household to $55.0K/household for multi-family/attached homes.

Advantages: The City's Park In-Lieu Fees will remain in synch with existing Los Altos land values and maximize the revenue needed to provide park or recreational facilities for population increases that occur with every new housing development in Los Altos.

Disadvantages: Developers will pay an additional 12.6% - 12.7% in Park In-Lieu Fees.

2) Option #2 – Do not move to adopt Resolution No. 2020-35.
Advantages: Developers will pay less fees.

Disadvantages: The City's Park In-Lieu Fees will not remain in synch with existing Los Altos land values and less revenue will be available to provide adequate park or recreational facilities for population increases that occur with new housing developments in Los Altos.

Recommendation
The staff recommends Option 1.

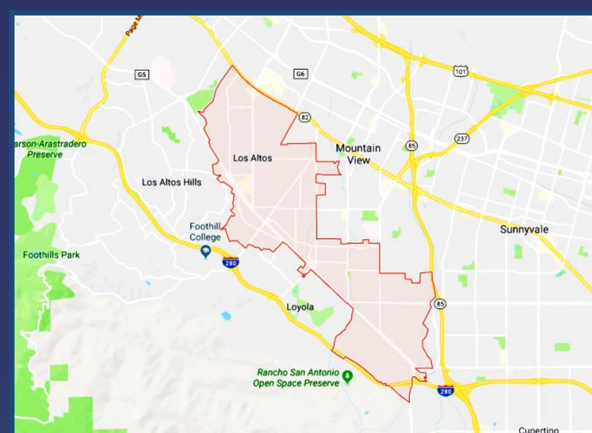
ATTACHMENT 1

Valbridge
PROPERTY ADVISORS

Appraisal Report

Unencumbered Residential Land
Los Altos, Santa Clara County, California 94022

Report Date: February 13, 2020



FOR:

City of Los Altos
Mr. Dave Brees
1 North San Antonio Road
Los Altos, CA 94022

Valbridge Property Advisors | Northern California

55 South Market Street, Suite 1210
San Jose, CA 95113
408.279.1520 phone
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Valbridge File Number:
CA02-20-0038

ATTACHMENT 1

55 South Market Street, Suite 1210
San Jose, CA 95113
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February 13, 2020

Maria Aji, PhD
408.279.1520, ext. 7120
maji@valbridge.com

Mr. Dave Brees
City of Los Altos
1 North San Antonio Road
Los Altos, CA 94022

RE: Appraisal Report
Unencumbered Residential Land
Los Altos, Santa Clara County, California 94022

Dear Mr. Brees:

In accordance with your request, we have provided appraisal consulting services regarding the range of current land values for unentitled land purchased in Los Altos for residential development. Our research and analysis is presented in this appraisal report. The attached report sets forth the most pertinent data gathered and our analysis.

We developed our analyses, opinions, and conclusions and prepared this report in conformity with the Uniform Standards of Professional Appraisal Practice (USPAP) of the Appraisal Foundation; the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute; and the requirements of our client as we understand them.

The purpose of this appraisal assignment is to develop an opinion of the market value of residential land in Los Altos. The land value range is provided in a per square foot value of the land. We are providing a range of values; the values are based on a site that is physically vacant and ready for development.

Unentitled residential land values are dependent on a variety of factors and are specific to individual properties. The range of values reported in this report are not specific to any single piece of property in Los Altos but rather reflect a range of values expected for land purchased in Los Altos that has residential development potential. The actual value for any specific property is dependent on factors such as the ease in which entitlements can be obtained, its location, school district, size, likely development density, etc. The values reported herein bracket a variety of these factors, as reflected in the current market.

The client in this assignment is City of Los Altos and the intended of this report is the City of Los Altos and no others. The sole intended use is for setting a park-in-lieu fee. The value opinions reported herein are subject to the definitions, assumptions, limiting conditions, and certifications contained in this report.

The findings and conclusions are further contingent upon the following extraordinary assumptions and/or hypothetical conditions, the use of which might have affected the assignment results:

Extraordinary Assumptions:

- None

Hypothetical Conditions:

- None

Based on the analysis contained in the following report, our value conclusions are summarized as follows:

Value Conclusion

Component	As Is
Value Type	Market Value
Property Rights Appraised	Fee Simple
Effective Date of Value	January 28, 2020
Value Range- Sinle Family Residential	**$150-$190 per sf**
Value Range Multi-Family Residential	**$300-$350 per sf**

The above range reflects the value of most vacant, unentitled residential land sites within Los Altos. Most land purchased in Los Altos is for condominium and mixed-use development. The adjusted range for such land is between $300 to $350 per square foot, while for single family residential land is $150 and $190 per square foot of site area.

Respectfully submitted,
Valbridge Property Advisors | Northern California

Maria Aji, Ph.D.
Senior Appraiser
California Certified License #AG027130

Norman C. Hulberg, MAI
Senior Managing Director
California Certified License #AG003542

Table of Contents

Introduction

Client and Intended Users of the Appraisal
The client in this assignment is the City of Los Altos and the sole intended user of this report is the City of Los Altos and no others.

Intended Use of the Appraisal
The sole intended use of this report is for setting a park-in-lieu fee.

Type and Definition of Value
The appraisal problem is to develop an opinion of the market value of the subject property. "Market Value," as used in this appraisal, is defined as "the most probable price that a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus." Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:

- *Buyer and seller are typically motivated.*
- *Both parties are well informed or well advised, each acting in what they consider their own best interests;*
- *A reasonable time is allowed for exposure in the open market;*
- *Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and*
- *The price represents the normal consideration for the property sold unaffected by special or creative financing or sale concessions granted by anyone associated with the sale."1*

The value conclusions apply to the value of the subject property under the market conditions presumed on the effective date of value.

Please refer to the Glossary in the Addenda section for additional definitions of terms used in this report.

Date of Report
The date of this report is February 13, 2020.

[1] *The Dictionary of Real Estate Appraisal*, Sixth Edition, (Appraisal Institute, 2015), 141

Special Note

Unentitled residential land values are dependent on a variety of factors and are specific to individual properties. The range of values reported in this report are not specific to any single piece of property in Los Altos but rather reflect a range of values expected for land purchased in Los Altos that has residential development potential. The actual value for any specific property is dependent on factors such as the ease in which entitlements can be obtained, its location, school district, size, likely development density, etc. The values reported herein bracket a variety of these factors, as reflected in the current market.

List of Items Requested but Not Provided

- None

Assumptions and Conditions of the Appraisal

This appraisal assignment and the opinions reported herein are subject to the General Assumptions and Limiting Conditions contained in the report and the following extraordinary assumptions and/or hypothetical conditions, the use of which might have affected the assignment results.

Extraordinary Assumptions

- None

Hypothetical Conditions

- None

Scope of Work

The elements addressed in the Scope of Work are (1) the extent to which the subject property is identified, (2) the type and extent of data researched, (3) the type and extent of analysis applied, and (4) the type of appraisal report prepared. These items are discussed as below.

Type and Extent of Data Researched

In preparation for this report, we reviewed the residential zoning designations in the city of Los Altos, as well as the application of the park in-lieu fee. We researched and analyzed regional and local economic trends, and analyzed and reported market trends relevant to Los Altos. Land sales that were purchased for residential development, located in and around Los Altos, were researched and analyzed. Adjustments were made to these sales to reflect factors such as entitlements and current market conditions, so that a current range of values for unentitled land could be concluded. These sales formed the basis for the opinions concluded in this report. The scope of work also included preparation of this report.

Appraisal Conformity and Report Type

We developed our analyses, opinions, and conclusions and prepared this report in conformity with the Uniform Standards of Professional Appraisal Practice (USPAP) of the Appraisal Foundation; the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute; and the requirements of our client as we understand them. This is an Appraisal Report as defined by the Uniform Standards of Professional Appraisal Practice under Standards Rule 2-2a.

Type and Extent of Analysis Applied (Valuation Methodology)

Appraisers develop an opinion of property value with specific appraisal procedures that reflect three distinct methods of data analysis: the cost approach, sales comparison approach, and income capitalization approach. One or more of these approaches are used in all estimations of value.

- <u>Sales Comparison Approach</u> - In the sales comparison approach, value is indicated by recent sales and/or listings of comparable properties in the market, with the appraiser analyzing the impact of material differences in both economic and physical elements between the subject and the comparables.
- <u>Direct Capitalization: Land Residual Method</u> - The land residual methodology involves estimating the residual net income to the land by deducting from total potential income the portion attributable to the improvements, assuming development of the site at its highest and best use. The residual income is capitalized at an appropriate rate, resulting in an indication of land value.
- <u>Direct Capitalization: Ground Rent Capitalization</u> – A market derived capitalization rate is applied to the net income resulting from a ground lease. This can represent the leased fee or fee simple interest, depending on whether the income potential is reflective of a lease in place or market rental rates.
- <u>Yield Capitalization: Subdivision Development Method</u> – Also known as Discounted Cash Flow Analysis (DCF), the methodology is most appropriate for land having multiple lot development in the near term as the highest and best use. The current site value is represented by

discounting the anticipated cash flow to a present value, taking into consideration all necessary costs of development, maintenance, administration, and sales throughout the absorption period.

We assessed the availability of data and applicability of each approach to value within the context of the characteristics of this valuation assignment and the needs and requirements of the client. Based on this assessment, we relied upon the sales comparison approach. Further discussion of the extent of our analysis and the methodology of each approach is provided later in the respective valuation sections.

Appraisal Conformity and Report Type

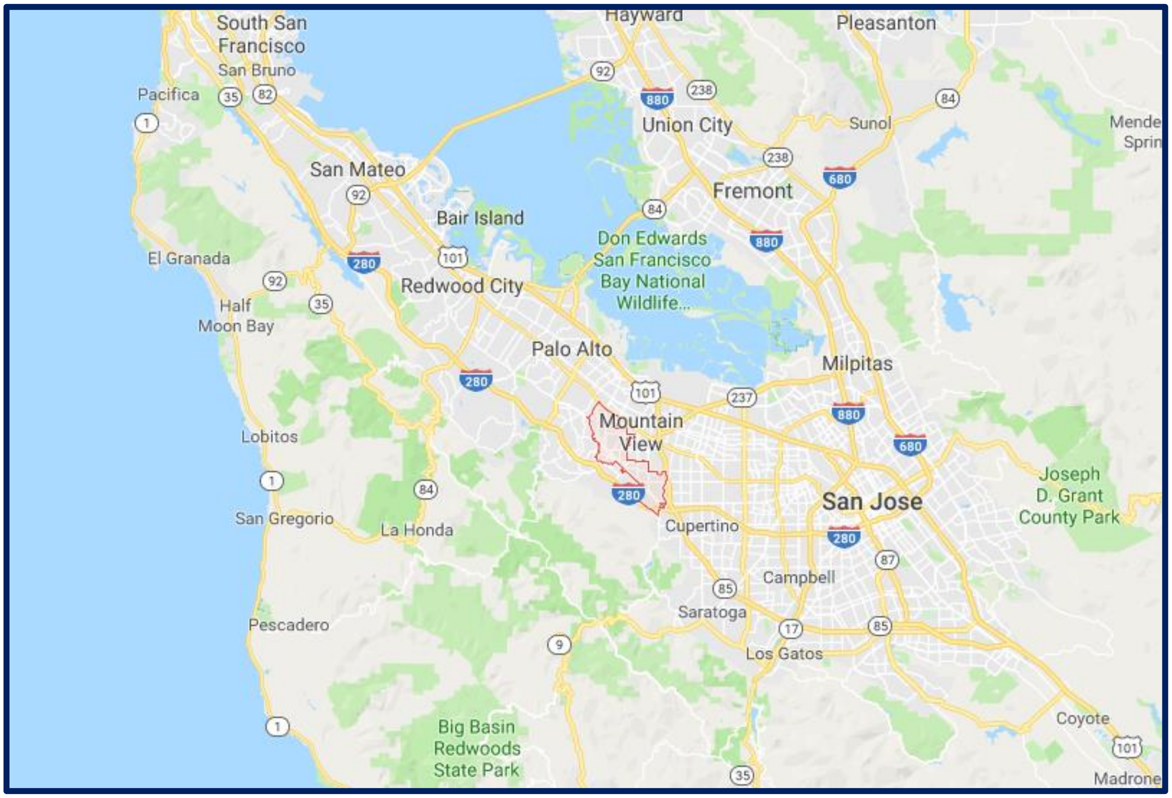
We developed our analyses, opinions, and conclusions and prepared this report in conformity with the Uniform Standards of Professional Appraisal Practice (USPAP) of the Appraisal Foundation; the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute; and the requirements of our client as we understand them. This is an Appraisal Report as defined by the Uniform Standards of Professional Appraisal Practice under Standards Rule 2-2a.

Personal Property/FF&E

All items of non-realty are excluded from this analysis. The opinion of market value developed herein is reflective of real estate only.

Regional and Market Area Analysis

REGIONAL MAP



Overview

The subject property is located in the San Francisco Bay Region, an area which is comprised of the nine counties bordering the San Francisco Bay. According to the State of California Department of Finance, the area had a combined population of approximately 7.78 million as of January 1, 2019 (most recent available). The Department of Finance characterizes the San Francisco Bay Area by a moderate climate, diversified economy and one of the highest standards of living in the United States.

Population

Santa Clara County is the most populous of the nine counties comprising the San Francisco Bay Region, with an estimated 1,954,286 residents as of January 1, 2019 according to the State of California Department of Finance. This was a decrease of 0.12% from the previous year. San Jose is the largest city in the county and the third largest in California, surpassing San Francisco.

According to the Site to Do Business projections, presented on the following page, the county's population is expected to increase annually 0.9% between 2019 and 2024, while Los Altos will increase approximately 0.6% annually over the same period.

Population

Area	2000	2010	Annual % Change 2000 - 10	Estimated 2019	Projected 2024	Annual % Change 2019 - 24
United States	281,421,906	308,745,538	1.0%	332,417,793	345,487,602	0.8%
California	33,871,648	37,253,956	1.0%	39,813,541	41,166,386	0.7%
Santa Clara County	1,682,585	1,781,642	0.6%	1,948,407	2,036,204	0.9%
Los Altos	28,137	29,001	0.3%	31,026	31,977	0.6%

Source: Site-to-Do-Business (STDB Online)

Transportation

Excellent transportation routes and linkages to all major cities within the region and throughout the state are primary reasons for the advancement of business activity in the Bay Area, including Santa Clara County.

Air service in the area is provided by Norman Y. Mineta San Jose International Airport, which accommodated over 14.3 million passengers in 2018. San Francisco and Oakland airports are also within an hour's drive from most portions of the county. In 2010, San Jose International Airport completed the first phase of a two-phase expansion with the goal of increasing service to 17.3 million travelers a year, at a cost of $1.3 billion. Planning for the second phase, nine additional gates and a new concourse extension at the south end of Terminal B, began early in 2018.

The area has a well-developed freeway system although traffic congestion is unquestionably one of the negative aspects. The county's transportation network also includes multiple expressways, which provide streamlined access to most interior locations. Lawrence Expressway, San Tomas Expressway and Foothill Expressway run north-south, while Central Expressway and Montague Expressway run roughly east-west.

Employment

High-technology employment and a skilled workforce translate into relatively high-income levels, and Santa Clara County is one of the most affluent metropolitan regions in the nation. Silicon Valley's economy is stable, although its narrow range of driving industries has kept recent growth very slow.

Significant employment sectors within Santa Clara County include manufacturing; professional, scientific, and technical services; health care; retail; and educational services. Some of the largest employers are associated with the computer industry such as Adobe, Apple, AMD, and Hewlett-Packard; hospitals such as the VA Medical Center, Kaiser Permanente, and the San Jose Medical Center; space and aerotech including NASA and Lockheed Martin; and educational facilities such as San Jose State University and Stanford University School of Medicine.

Employment by Industry - Santa Clara County

Industry	2019 Estimate	Percent of Employment
Agriculture/Mining	5,119	0.50%
Construction	57,329	5.60%
Manufacturing	166,867	16.30%
Wholesale trade	19,451	1.90%
Retail trade	83,946	8.20%
Transportation/Utilities	32,759	3.20%
Information	50,163	4.90%
Finance/Insurance/Real Estate Services	49,139	4.80%
Services	531,314	51.90%
Public Administration	25,593	2.50%
Total	1,023,726	100.0%

Source: Site-to-Do-Business (STDB Online)

Unemployment

The unemployment rate in Santa Clara County is currently less than the rates of the state and nation. The County unemployment rate was 2.3% as of November 2019 (most recent available). The State of California was at 3.9% while the Nation was at 3.5% for the same time period. Unemployment rates locally and nationwide have been on a decreasing trend over the last several years, as shown in the table below.

Unemployment Rates

Area	YE 2012	YE 2013	YE 2014	YE 2015	YE 2016	YE 2017	YE 2018	YTD 2019
United States	7.9%	6.7%	5.6%	5.0%	4.7%	4.1%	3.9%	3.5%
California	9.7%	8.3%	6.9%	5.7%	5.3%	4.4%	4.1%	3.9%
Santa Clara County	7.0%	5.5%	4.3%	3.7%	3.4%	2.7%	2.4%	2.3%
Los Altos	4.6%	3.6%	2.8%	2.4%	3.1%	2.7%	2.2%	2.1%

Source: Bureau of Labor Statistics - Year End - National & State Seasonally Adjusted

The information below was obtained from the "UCLA Anderson Forecast for the Nation: December 2019 Report," presented by the UCLA Anderson School of Management.

National Economic Overview

UCLA Anderson Forecast lightened its 2020 outlook at the end of 2019. Instead of predicting 1% real growth for 2020, growth is now expected to be at 1.7% on a fourth-quarter-to-fourth-quarter basis. Senior economist David Shulman warns, though, that although at a reduced level from the previous warning, the second half of 2020 is still at risk of recession. Some of the economic risks are described below.

"After going on a separate track from business investment, we forecast a slowdown in consumer spending, largely coming from much weaker automobile sales as credit tightens in that sector," writes Shulman.

The interest rate environment (aside from auto credit) is expected to remain stable, but economic performance has diverged as strong consumer spending has masked weakness in business investment. This comes as a surprise to economic experts as the 2017 Tax Act was expected to spur spending on capital improvements. After a close look at the data, analysts are sounding the alarm to proceed with caution.

Some economists, however, are still optimistic and resolve to take the GDP's growth at face value while taking a wait-and-see approach regarding the effects of trade issues and tax cuts. Job growth has trended upward over the last several years but is expected to slow down in 2020, especially with the closure of retail chains unable to compete with e-commerce. Inflation is anticipated to rise modestly above 2%.

In commercial real estate, the success of e-commerce has shifted demand toward industrial space, yielding increased rents and new construction in this sector. Schulman writes, "E-commerce has accounted for 34% of the growth in the addressable market since 1999 and an astounding 47% of the growth in the five years ending in the fourth quarter of 2018." This changing demand presents an uncertain future for brick and mortar retail.

In more news at the end of 2019, Boeing announced that it will halt production of its 737 Max airplanes after catastrophic crashes. Boeing is the largest U.S. exporter, and the freeze will affect manufacturers both domestically and internationally. Some economists are predicting layoffs at Boeing and among its suppliers if the production halt lasts beyond the first quarter. This is one more potential cause of a drop in GDP growth, by as much as 0.5% in the first quarter of 2020.

Another indicator of a slowing economy is slowing housing activity. Although the number of housing starts doubled from 600,000 to approximately 1.2 million in the past several years, housing activity has yet to reach the normalized value of 1.4-1.5 million. Even with a significant drop in rates, housing activity has stalled at 1.2 million, but 2021 may offer a recovery.

Federal Funds Rate

In an effort to maximize employment and stabilize inflation, the Federal Reserve Bank raised the federal funds rate ten times from 2015, when interest rates were almost zero, to 2018. The table to the right summarizes the previous ten rate changes occurring over the past five years. The Fed had consistently been increasing by 25 basis points. The rate was raised twice in 2015, once in 2016, three times in 2017, and four times in 2018. Then in August 2019, the Fed lowered its rate for the first time in a decade. Two more decreases came in September and October.

"In light of the implications of global developments for the economic outlook as well as muted inflation pressures, the Committee decided to lower the target range for the federal funds rate to 1.25% - 1.75%," the Federal Open Market Committee said in a press release dated October 30, 2019.

Federal Funds Rate

Date	Target Range (%)	Basis Point Change
15-Dec	0.25% - 0.50%	+25
16-Dec	0.50% - 0.75%	+25
17-Mar	0.75% - 1.00%	+25
17-Jun	1.00% - 1.25%	+25
17-Dec	1.25% - 1.50%	+25
18-Mar	1.50% - 1.75%	+25
18-Jun	1.75% - 2.00%	+25
18-Sep	2.00% - 2.25%	+25
18-Dec	2.25% - 2.50%	+25
19-Aug	2.00% - 2.25%	-25
19-Sep	1.75% - 2.00%	-25
19-Oct	1.50% - 1.75%	-25

Lowering interest rates is the Fed's main way to boost the economy, so many are asking why the rate was decreased while things are still in good shape in the United States. Top Fed officials are defending the move as an "insurance cut" to counteract the negative effects of the intensifying trade war. The rate cuts were made to maintain the economic expansion the United States economy is still enjoying.

The California Forecast

The California economy is still growing at a faster rate relative to the rest of the nation, however, its growth is still slowing down. UCLA Anderson Forecast Director Jerry Nickelsburg posits that this is in part because unemployment rates in California are very low.

Therefore, it follows that the rate of hiring should slow down," Nickelsburg writes, "Through April of this year, that had not happened. Indeed, the rate of hiring for non-farm payroll jobs increased by 0.2 percentage points from 2018's hiring rate. At some point, capacity constraints become binding, and with the October job numbers in place, there are indications that [the slowdown in hiring] has occurred."

California is forecasted to incur employment growth rates of 0.9% and 1.3% in 2020 and 2021, respectively. Nickelsburg also writes that weakness in homebuilding, even with looser regulations and more flexible zoning, means that the prospect of the private sector solving California's housing crisis over the next three years is slim to none.

Median Household Income

In Santa Clara County, San Jose, the county seat, ranks first out of the entire nation in terms of median household income for major metropolitan areas. San Francisco, about 50 miles to the north of San Jose, also ranked as one of the wealthiest cities in the nation: it holds the number two spot with a median household income of about 9% less than San Jose.

Total median household income for the region is presented in the following table. Overall, the subject compares favorably to the state and the country.

Median Household Income

Area	Estimated 2019	Projected 2024	Annual % Change 2019 - 24
United States	$60,548	$69,180	2.9%
California	$74,520	$86,333	3.2%
Santa Clara County	$120,756	$141,095	3.4%
Los Altos	$200,001	$200,001	0.0%

Source: Site-to-Do-Business (STDB Online)

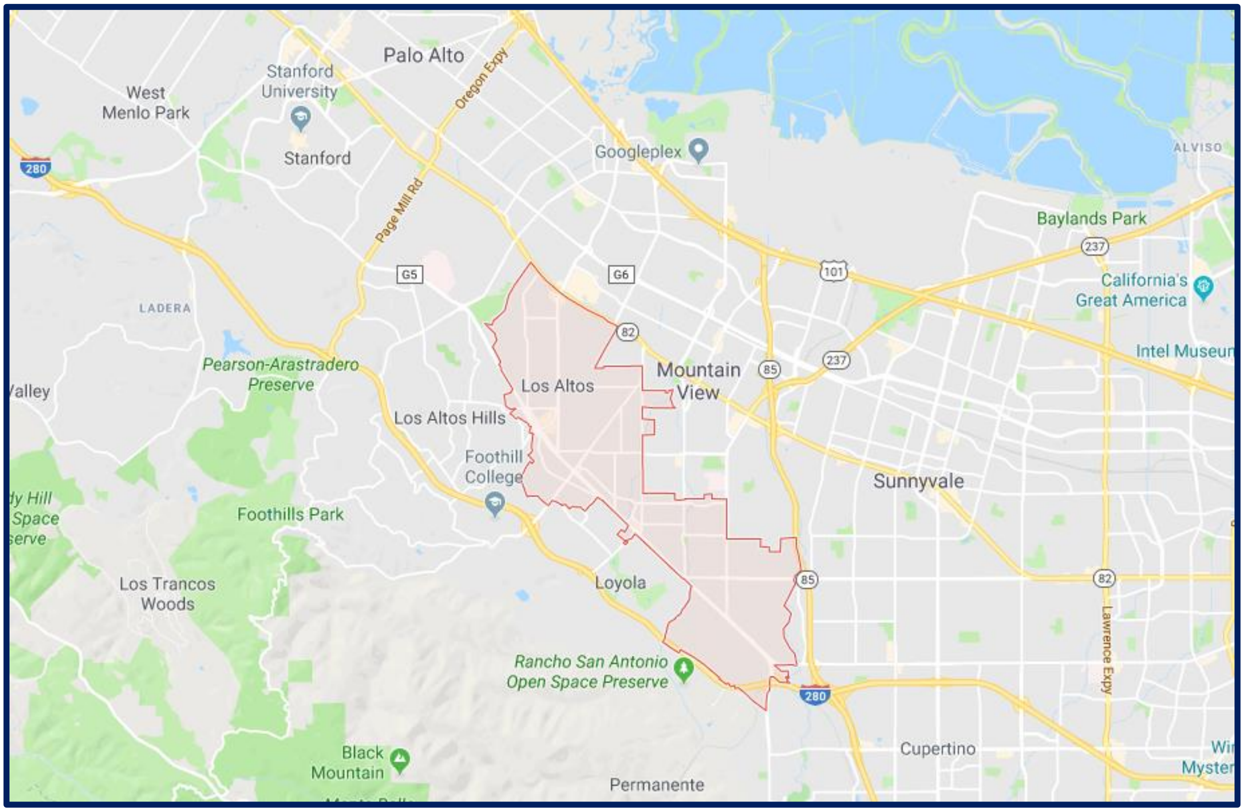
Conclusions

Historically, the Santa Clara County region has been considered a desirable place to both live and work. Physical features and a strong local economy attract both businesses and residents. It is a worldwide leader in technology and a regional employment center, with an increasingly diversified economy. While traffic congestion will continue to be a problem, residents remain among the most affluent in the country.

Nationwide, we are in a period marked by volatility in American politics. Nonetheless, the nation has experienced real growth and modest inflation in the current economic cycle. Although the economy is operating at or close to full employment, the Fed has lowered interest rates in an effort to maintain growth patterns. The current political environment creates a degree of uncertainty, however, in the long-term economic forecast. In the near term, 2020 is expected to be prosperous, even if at a slower pace than recent years.

City and Neighborhood Analysis

NEIGHBORHOOD MAP



Incorporated in December 1952, the City of Los Altos is a relatively small, suburban community. Located 37 miles south of San Francisco and 16 miles northwest of San Jose, the city encompasses seven square miles and is bordered by Los Altos Hills, Palo Alto, Mountain View, Sunnyvale, and Cupertino. Los Altos is a General Law City, with five elected council members serving four-year terms. The city's climate is considered Mediterranean with average temperatures ranging from a low of 37.5 to a high of 83.9 degrees and a mean average yearly rainfall of 17.47 inches. Los Altos is a desirable upscale community with tree-lined streets and high-quality public schools.

Situated in the western portion of Santa Clara County, Los Altos has excellent access to local and regional transportation networks. It is home to numerous recreational and shopping opportunities. Annual events include Los Altos Kiwanis Club Pet Parade, Los Altos Rotary Club Fine Art Show, Downtown Los Altos Arts and Wine Festival, Los Altos Fall Festival, and Festival of Lights Parade.

The City is known for its exceptional schools. As ranked by California's Academic Performance Index, all eight schools, six elementary and two junior-high, in the Los Altos School District are among the top 1% of schools in the state. The vast majority of kindergarten through eighth grade students in Los Altos and Los Altos Hills are served by the Los Altos School District. Serving students in grades nine through twelve from Los Altos, Los Altos Hills, and Mountain View is the Mountain View-Los Altos Union High School District. Students residing in the most southern portion of Los Altos attend an elementary and junior high school located in the highly desirable Cupertino Union School District. With

Foothill College located in nearby Los Altos Hills, Los Altos is within a short distance of numerous colleges and universities including De Anza as well as Mission Colleges along with San Jose State, Santa Clara, and Stanford Universities.

Residential Market Overview

The Bay Area residential market has historically experienced demand and value levels amongst the strongest in the nation. From 2012 to 2018, prices have steadily increased as the economy has fully recovered from the recession and tech companies in the Bay Area continue to pay top dollar for top talent. In late 2018 and early 2019, some cooling was noted in the market, however, prices remain stable.

The strength in for-sale and rental housing is also fueling an increase in demand for land suitable for residential development. Land values have increased significantly over the past few years, as higher sale prices and rents make development both feasible and profitable. An overview of the various residential markets is provided below and on the following pages.

Santa Clara County and Los Altos For-Sale Market

Residential land values are directly tied to supply and demand of current housing product. Land values vary depending on location, size, permitted uses, and allowable density. Due to the limited number of true land sales, it is difficult to infer meaningful data from sales statistics in this category. However, with the prices of homes going up, land prices have also experienced a notable upward trend over the past years. The Bay Area and Santa Clara County are both experiencing explosive growth, in large part due to the various tech companies located in the area, and thus, these areas command some of the highest home prices in the region. Prices are expected to continue to increase over the next year at slower rates, which puts upward pressure on land values.

The Bay Area marketplace has historically been characterized as among the most expensive housing markets in the nation. The following table highlights median prices for both detached and attached housing within the City of Los Altos and Santa Clara County, as reported by the local Multiple Listing Service.

HISTORICAL MEDIAN SINGLE FAMILY & CONDOMINIUM HOUSING PRICES

City of Los Altos & County of Santa Clara					2016-2017	2017-2018	2018-2019
		2017	2018	2019	% change	% change	% change
SFR	Los Altos	$3,018,631	$3,400,000	$3,288,000	11.39%	12.63%	-3.29%
	County	$1,170,988	$1,330,000	$1,255,000	15.37%	13.58%	-5.64%
Condo	Los Altos	$1,465,000	$1,600,000	$1,619,444	-0.34%	9.22%	1.22%
	County	$635,000	$765,000	$720,000	9.48%	20.47%	-5.88%
Town Home	Los Altos	$1,862,000	$1,950,000	$1,685,000	32.06%	4.73%	-13.59%
	County	$900,000	$1,099,535	$953,500	13.21%	22.17%	-13.28%

The preceding table shows a decrease in single-family home and townhome prices over the past year for both the City of Los Altos and the County as a whole, after increases in almost all areas the two years before. We note, however, that the home price decline was not as less significant than the decline experienced in the County as a whole. We also note that the price of condos increased in Los Altos, while it declined in the County as a whole. Higher density condominium development is the preferred type of development at present, both in Los Altos as well as in the Bay Area as a whole, especially in downtown areas.

This home price decline could very well signify that we have reached the top of this cycle and are flattening out, especially as home prices have reached a point that is unattainable for all but a few in this area. It can also mean a shift in people's preferences, from Single Family Homes towards more compact, downtown living. However, as is discussed below, while the for-sale market segment is tightening, the multi-family rental market continues to be strong.

Los Altos Multi-Family Overview

Below is Fourth Quarter 2019 Multifamily market information published by CoStar Analytics.

The Mountain View/Los Altos submarket is home to some of the area's largest employers, including Google, Intuit, and Microsoft. This concentration of employers and jobs has led to strong demand for housing, especially multifamily units. Developers have responded to the demand, adding more than 1,500 units to the submarket since 2010. New construction projects continue to break ground, with even more projects on the horizon in the next few years. Sales activity has been moderate in the submarket. Most transactions taking place in value-add deals in the older stock of inventory.

KEY INDICATORS

Current Quarter	Units	Vacancy Rate	Asking Rent	Effective Rent	Absorption Units	Delivered Units	Under Constr Units
4 & 5 Star	2,023	13.8%	$4,383	$4,330	5	0	802
3 Star	4,084	4.5%	$3,149	$3,135	(3)	0	415
1 & 2 Star	7,143	3.7%	$2,339	$2,326	(1)	0	0
Submarket	**13,250**	**5.5%**	**$3,092**	**$3,069**	**1**	**0**	**1,217**

Annual Trends	12 Month	Historical Average	Forecast Average	Peak	When	Trough	When
Vacancy Change (YOY)	0.8%	4.6%	5.9%	6.5%	2013 Q1	2.0%	2000 Q2
Absorption Units	53	66	268	513	2017 Q3	(361)	2001 Q4
Delivered Units	204	96	316	567	2017 Q3	0	2019 Q2
Demolished Units	34	7	11	74	2014 Q4	0	2019 Q3
Asking Rent Growth (YOY)	1.1%	2.1%	1.1%	22.4%	2001 Q1	-13.3%	2002 Q3
Effective Rent Growth (YOY)	1.3%	2.0%	1.1%	22.4%	2001 Q1	-13.5%	2002 Q3
Sales Volume	$311 M	$81.5M	N/A	$317.4M	2019 Q3	$5.6M	2010 Q4

Source: Costar

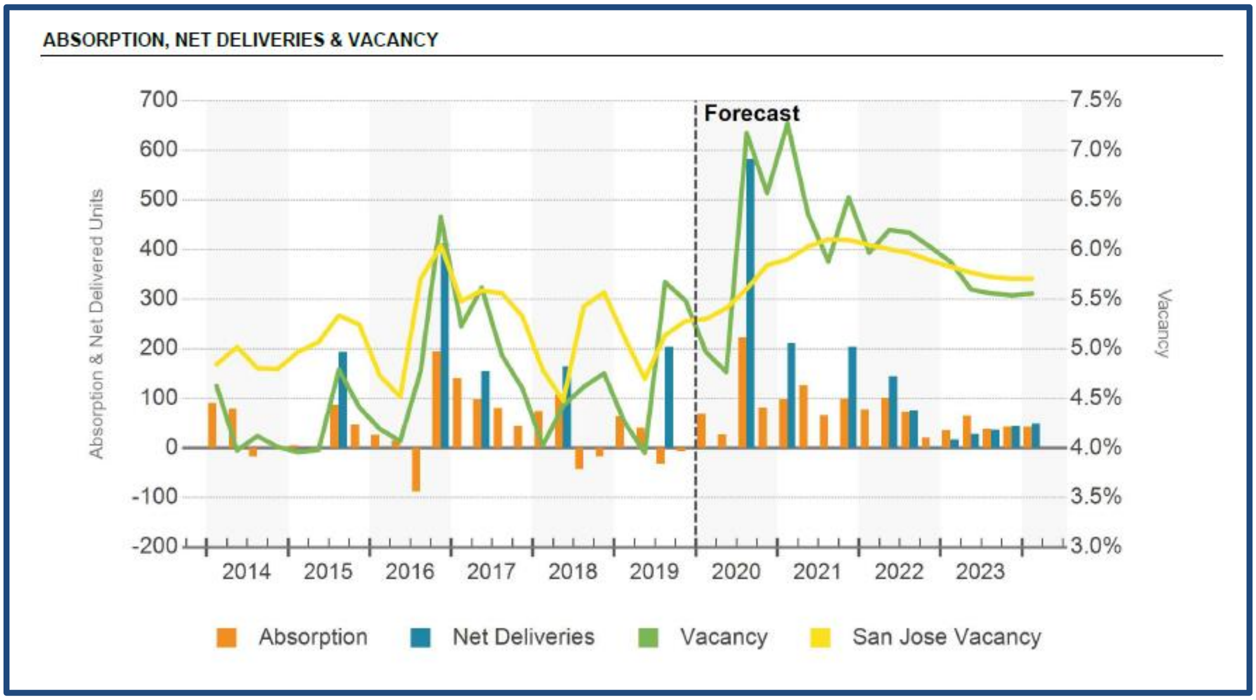
Vacancy

The Mountain View/Los Altos sub-market is a desirable one at the center of one of the world's hottest economies. Developers have responded to the demand, with new constructing surging since 2013. Since that time, eight significant developments, each with an average of more the 200 units, have been completed.

Demand for the new apartment stock has been robust, and submarket vacancy registers just 5.5% despite the supply additions. Two of the metros employers, Google and LinkedIn, have a major presence in the submarket. Population growth has also helped drive demand for apartments, with the submarket adding around 10,000 residents since 2010, amounting to growth of nearly 10%.

With single-family home prices in Mountain View/Los Altos among the highest in the metro, well over $1 million on average, even highly paid tech employees will find it challenging to buy a home. As a result, transitioning to homeownership should not be a significant drag on near-term apartment demand.

Development activity is set to continue in the submarket, as the City of Mountain View has finalized plans for its North Bayshore where nearly 10,000 homes and apartments, and 3.6 million square feet of office space are slated for development through 2030. The new neighborhoods in the North Bayshore will be dense - apartment buildings will be as tall as 15 stories, and the city has targeted 70 percent of the units for studio or one-bedroom apartments. Google owns slightly more than half of the land slated for residential development. Development timelines have not been set.



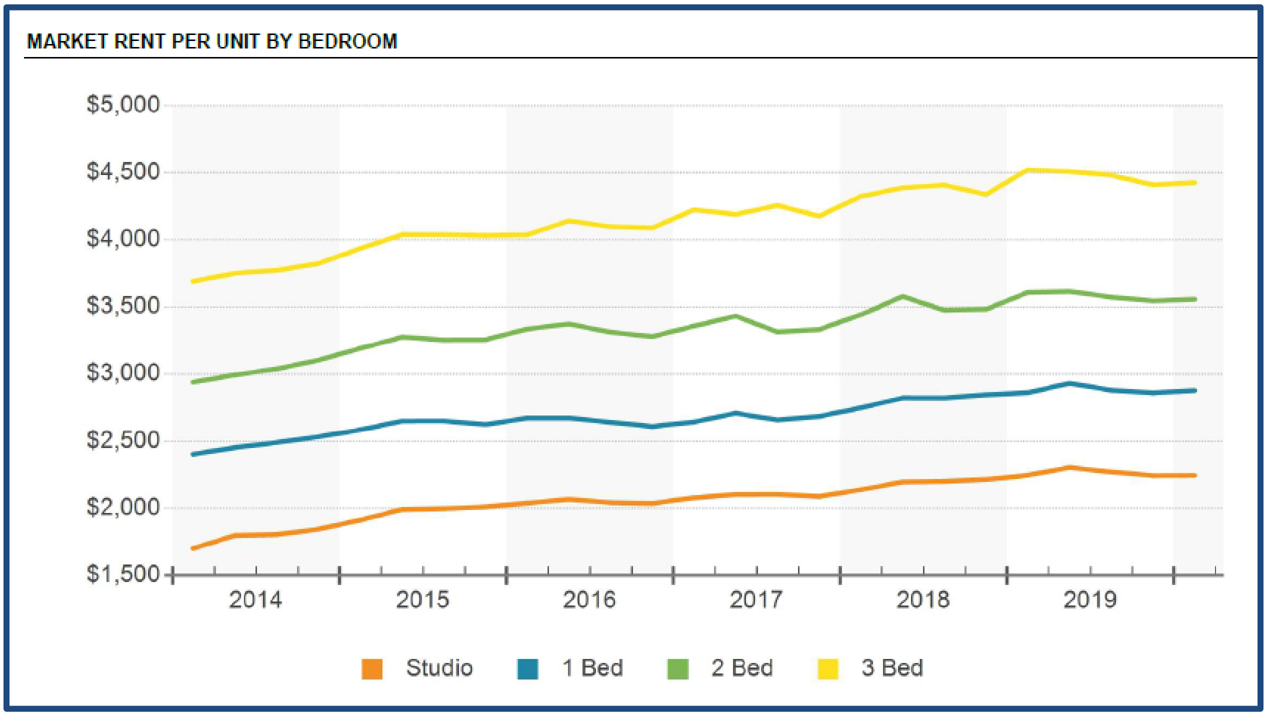
Source: CoStar

Rent

Apartment rents in the submarket come at a premium due to the submarket's central location in Silicon Valley and proximity to the office headquarters of leading technology firms. Apartment rents average $3,090/unit, more than 10% above the San Jose market average.

Demand is strong in Mountain View and Los Altos, as apartments in the submarket command high rents, despite being of older and lower quality. Only around 15% of the submarket's apartment stock is rated 4 & 5-star quality, compared to 30% in the broader market. This may explain why average rent levels are lower in Mountain View than in neighboring Cupertino, where around a quarter of units are 4- & 5-Star.

Units in 4- & 5-Star buildings rent for a significant premium over 1- & 2-Star units. For newly constructed buildings, rents are especially high - average asking rents in buildings delivered since 2013 range from $4,000 to $5,000/month.



Source: CoStar

Construction

As mentioned previously, developers have responded to the tight market conditions in Mountain View/Los Altos with a surge in construction and have delivered 1,500 units since 2013. More units are set to come online in the next few years, roughly 1,200 units are currently being built. Other areas of the metro area are adding even more units, and more units as a percentage of their total inventory, than this submarket.

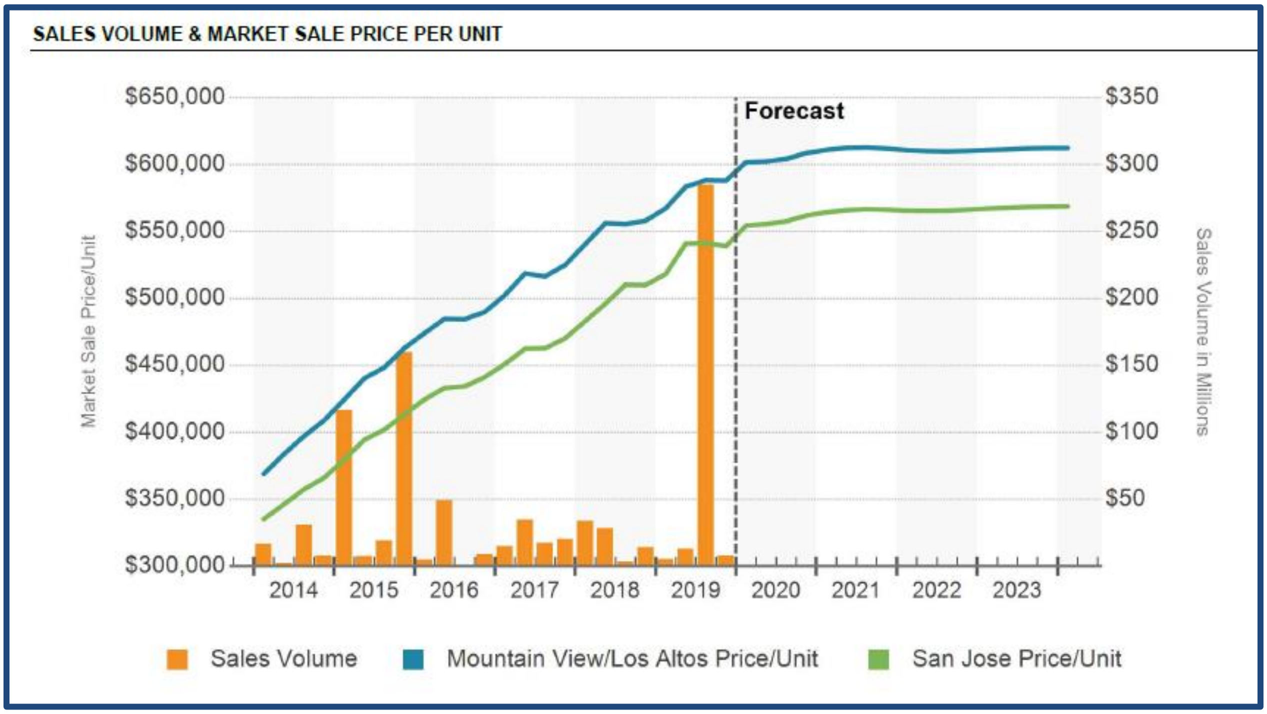
Between Mountain View and Los Altos, construction is primarily taking place in Mountain View, which makes up most of the submarket with a population of around 80,000. Los Altos, which is smaller with a population of about 30,000, also has much more restrictive zoning. The city has added just 325 units since 2009, the most recent being Colonnade, a 167-unit 4 Star building that shows the difficulty that employers may face in retaining their workforces in the face of the area's housing crunch. To secure housing, Stanford University has preleased the entire complex and plans to rent the apartments to faculty.

Sales

High rents and steady rent growth due to strong demand in this submarket have resulted in some of the highest pricing in the metro. Pricing for Mountain View/Los Altos multifamily assets average roughly $600,000, which trails only a few other submarkets in this metro, such as Palo Alto.

Ownership turnover in Mountain View/Los Altos is slow in comparison to surrounding areas. The submarket contains nearly 30 apartment properties of over 100 units, and only six of those have changed hands since the '90s.

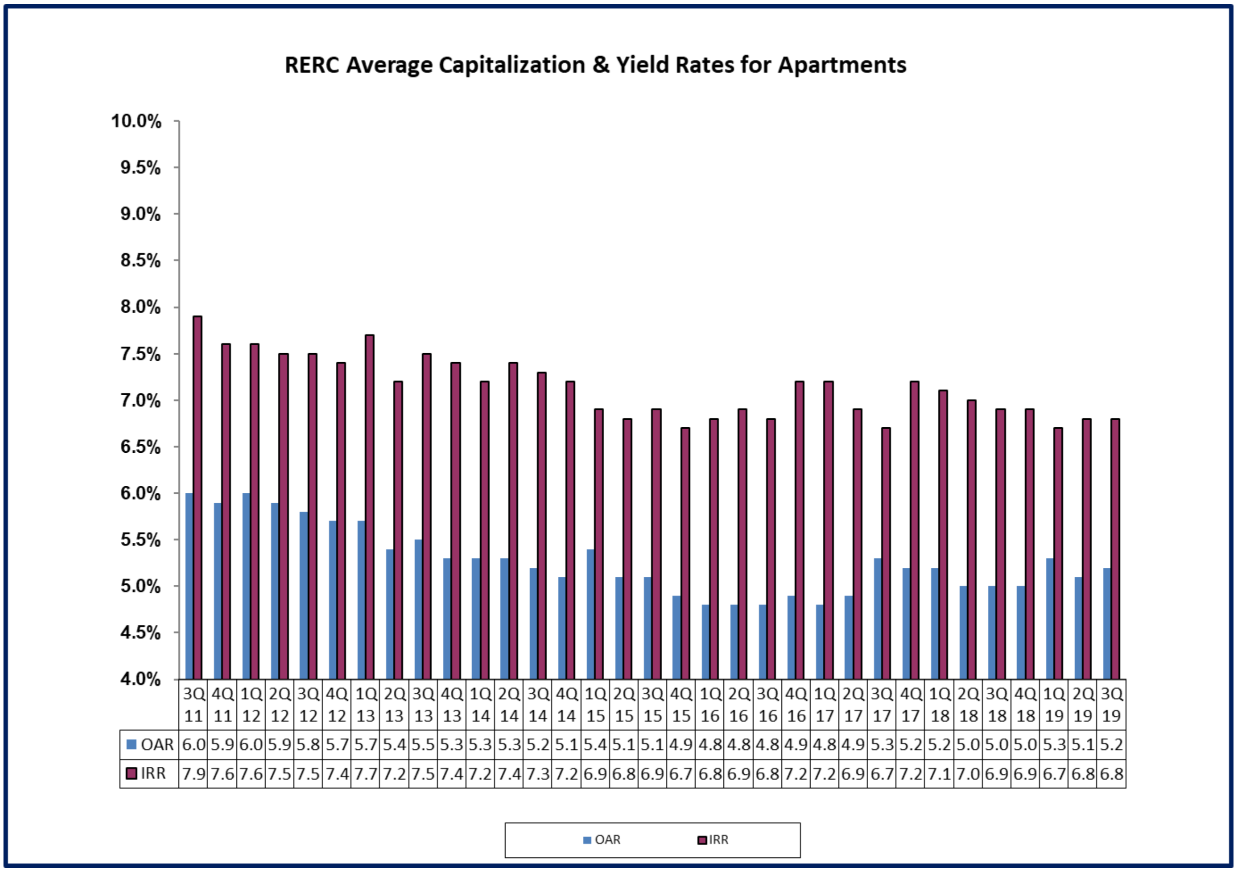
Lower-end properties have sold more often in the past few years. These smaller assets, often built in the 1960s, have commanded pricing in the $400,000/unit range. Many older properties in the area are ripe for value-add investment.



Source: CoStar

Capitalization & Yield Rate Trends

We have also considered the historical average capitalization and yield rates for apartment properties over the last five years, as reported by the Real Estate Research Corp. ("RERC") and CoStar Analytics. The historical rates are illustrated in the following table noted on the following page.



Rates have been falling, albeit not consistently, since 2009. In the 3rd quarter 2011, the average cap rate was about 6.0% and the average yield rate was about 7.9%. Since then, rates have decreased significantly. The average cap rate as of the Third Quarter of 2019 was 5.2% and the average yield rate was 6.8%.

Land Market Overview

Residential land values are directly tied to supply and demand of current housing product. Land values vary depending on location, size, permitted uses, and allowable density. Unfortunately, there are no meaningful statistics for residential land values in Santa Clara County and the subject's submarket of Los Altos. However, with the prices of homes going up, land prices have also experienced a notable upward trend over the past years. The Bay Area and Santa Clara County are both experiencing growth, in large part due to the various tech companies located in the area, and, thus, these areas command some of the highest home prices in the region. While home prices appear to be stabilizing at present, they are expected to continue to increase over the next year, which puts upward pressure on land values.

Residential land is typically purchased contingent on project approval or with entitlements (tentative or final map) in place. When contingent upon approvals, the risk to a developer is significantly reduced, putting upward pressure on the price. Prices for land purchased without this contingency are typically lower than for land purchased on a contingency. The price differential is especially large as the risk increases. We note that citizen participation in planning activities is very high in certain municipalities; thus, the approval process for residential projects can become political, long and arduous. It is not uncommon for new projects to take three to four years for development approval.

The Bay Area and Santa Clara County residential land market has been very active over the past two years. Several land transactions took place, many of which had short escrows without a tentative map approval contingency. The real estate brokers we spoke with indicated that marketing periods for these sales were short, and some properties had multiple offers, which resulted in contract prices that were at or above the asking rate. However, most of the sales that are currently taking place are sales of subdivision land suitable for medium- and high-density residential development.

We note that the Los Altos residential market is not very active and there have been only a couple of recent sales in Los Altos. Most of these properties were improved sites, where the improvements contributed limited to no value to the land and the intention was to redevelop the sites. Many sales in the area are for mixed-use development, along the El Camino Real corridor. We were only able to find a handful of new sales for townhome, condo or single-family residential development to base our value conclusions and we have, thus, expanded our research to other nearby cities.

Buyer types range from the individual developer to the large-scale national housing developer, depending on the size of the site. Well-located, small sites are still in demand from small local buyers, while national builders are very actively seeking land sites that are over three acres in size. If a property has easy access, no topographic or geologic issues, and has infrastructure available, the property will be in higher demand. In addition, higher density land for affordable developments is exhibiting equal demand than for-sale housing at this time.

Residential land in Santa Clara County sells in the \$80-to-\$500+-per-square-foot range. The upper end of the range is indicated by urban markets such as downtown San Jose or in markets with major high-technology employers such as Palo Alto/ Menlo Park (headquarters of Facebook), Cupertino (headquarters of Apple), and Mountain View (headquarters of Google). These markets, easily accessible and usually fronting more than one major freeway benefit from excellent access and are proximate to both demand as well as employment generators.

Oftentimes, residential land is valued on the basis of price per unit as opposed to price per square foot, particularly for entitled sites. High-density residential land throughout the Bay Area currently ranges between \$75,000 up to \$500,000+ per unit. The higher end of this range is indicative of primary markets or "A" locations within Santa Clara and San Mateo County. The "B" locations, which are usually proximate to employment centers, in San Jose, Santa Clara, Milpitas, generally range from \$75,000 to over \$180,000 per unit. According to our survey of market participants, Los Altos is considered to be an "A" type location given its proximity to employment centers, natural setting and the reputation of the school district.

Market Summary/Conclusions

In summary, the residential market continues to be strong, with value increases evident in the for-sale, rental and land markets. Palo Alto, Los Altos and Mountain View are more expensive locations as compared to Sunnyvale, Santa Clara and San Jose. All else being equal, land values track home values and rents although not necessarily in the same proportion. Land values of sites with entitlements are higher than those without entitlements due to the level of risk involved in obtaining entitlements. Many times, a buyer will agree to purchase a site contingent on receiving entitlements, then proceed with obtaining the entitlements, and finally close escrow only after the entitlements are secured. Again, this reduces risk to a developer/buyer and puts upward pressure on the purchase price. These factors are considered in our analysis.

Park in Lieu Fee

According to Section 13.24.010 of the Los Altos Municipal Code, as a condition of approval of a final subdivision or parcel map, the subdivider shall dedicate land, pay a fee in lieu thereof, or a combination of both at the option of the city, for park or recreational purposes. The planning commission shall, upon approving a tentative map, recommend the conditions necessary to comply with the requirements for park land dedication or fees in lieu thereof as set forth in this section, and such conditions shall be attached as conditions of approval of the map. Table B-44, reproduced below, presents the current Park Land Dedication in-Lieu Fees.

According to our client, the City of Los Altos recently raised the Park Land Dedication In-Lieu Fees. The current fees are $77,500 for single family residential units and $48,000 for multiple family residential units. This is a significant (35%+) increase from the previous 2014 fee structure but is a result of increasing land values in Los Altos and the Bay Area in general.

Since the fee for both subdivisions and multifamily rental housing is based on the fair market value of the land that otherwise would have been required, the fee is based on the value of land that is purchased for residential development, not for commercial or industrial development. As this report will be used to establish the park in-lieu fee, the most appropriate land sales to research and analyze, therefore, are those for residential development.

We note, however, that most of the projects that are currently approved are for mixed use projects that contain a retail component alongside the residential component. The retail component often represents a small portion of the development, and the value is created by the residential component. There have been cases, however, that the residential is only a small portion of the larger development. This element will be considered in our analysis.

Land Valuation

Introduction

The estimation of market value involves a systematic process in which the problem is defined and the data required is gathered, analyzed, and interpreted into an estimate of value. The best way to estimate the value required for this report is to research and analyze actual sales of residential land, both land for low density as well as higher density projects. These sales can then provide a range of value for residential land in Los Altos. This method is known as the Sales Comparison Approach.

Sales Comparison Approach

The most common way of valuing land is the Sales Comparison Approach, in which recent sales or offerings of vacant land are gathered and analyzed. Typically, the values indicated by the comparable transactions are reduced to a unit of comparison, such as sale price per square foot of land area. This is the most common unit of analysis for unentitled land, where the number of units to be constructed on a site is unknown.

In a typical appraisal, each comparable sale is adjusted to the subject for differences in market conditions, sale conditions, location, physical characteristics, zoning, or other significant differences. For this assignment, however, there is no single subject property. The purpose of this assignment is to provide a range of values for unentitled, residential land in Los Altos. The values reported herein, therefore, bracket a variety of the factors mentioned above, as reflected in the current market.

Analysis of Los Altos Residential Land Sales

An investigation was made of recent sales of unentitled, residential land located in Los Altos. As noted earlier, however, residential land is typically sold contingent on project entitlements. Sites sold with this contingency sell at higher prices than land that is sold “as is,” without this contingency.

Another challenge we were presented with in our search for comparable residential land sales is that it was difficult to find “pure” residential land sales. Most cities currently require a retail component on the ground floor of high-density residential projects, especially those located along main thoroughfares or within downtown areas.

Given that we were unable to find sufficient pure residential land sales without contingencies, we included sales of sites that sold with contingencies or entitlements, but made adjustments for this factor so as to provide an appropriate range of value for unentitled land. We similarly adjusted mixed-use land sales for the ground floor commercial component, if appropriate.

The most recent sales that we were able to research and confirm are summarized in the table on the following page. We note that the Los Altos residential land market appears to be picking up, as we were able to find at least three new land sales in 2019 and three sales in 2018. We are aware of one additional offer for residential land in Los Altos. This sale is being negotiated currently. We have not included this transaction in the table as we were unable to confirm the terms of the transaction.

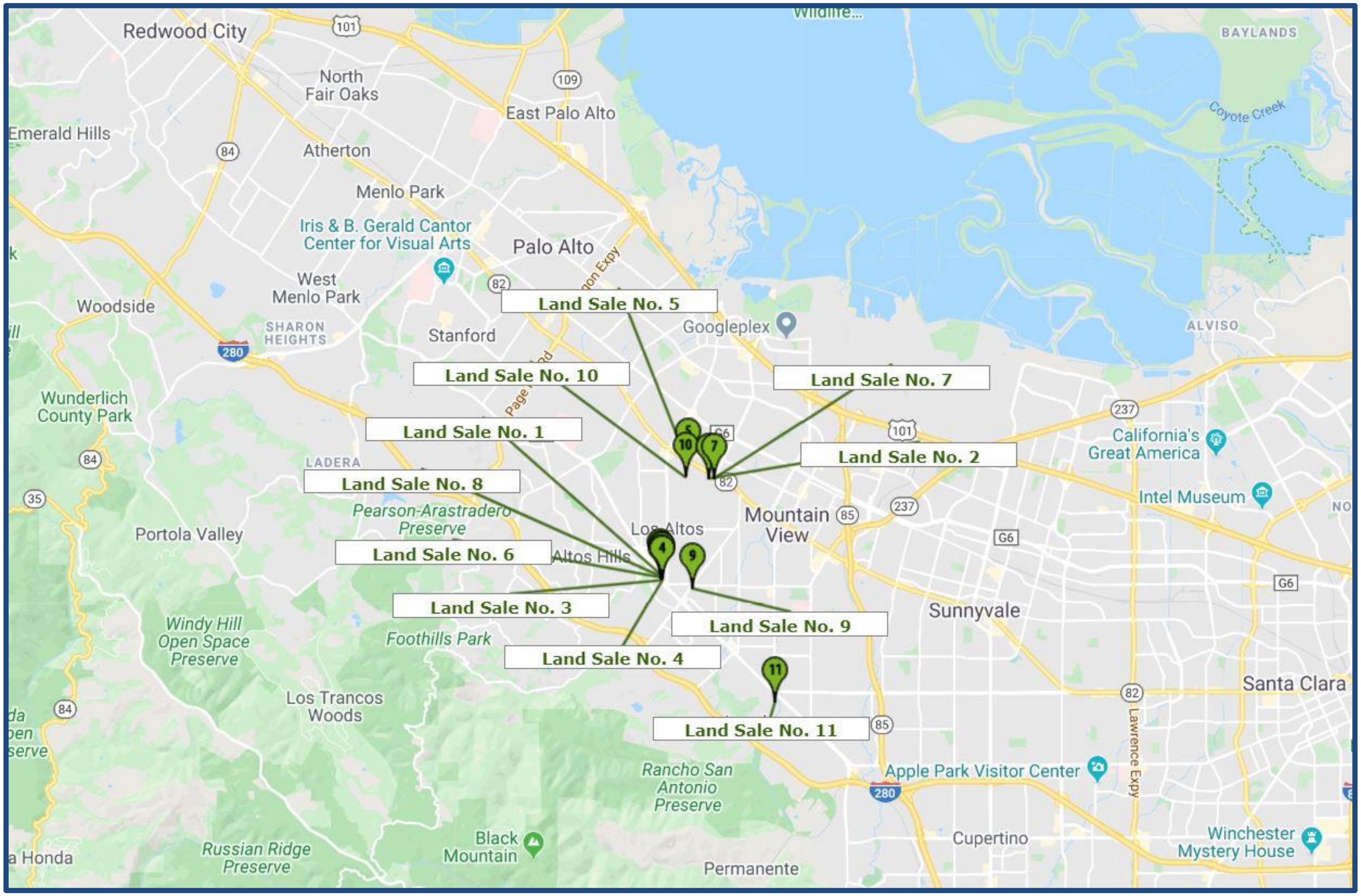
We have supplemented the sales located in Los Altos with additional sales located in the areas surrounding Los Altos, namely Mountain View, Palo Alto and Cupertino. After adjusting these sales for their general locations relative to Los Altos, these additional sales support the land value range indicated by the Los Altos sales. The locational adjustments are based on the medium home price and rental rates within each comparable city, as compared to the subject.

First, the sales located in Los Altos are summarized in the table on the next page, followed by a Location Map. The Los Altos sales range in size from 0.126 to 3.796 acres and before adjustment, range in price from $127.15 to $600.55 per square foot of land area. They represent a broad range of residential land values in Los Altos. Details of each sale follow the Location Map. As discussed, later in the report we also present and analyze additional sales from the surrounding area.

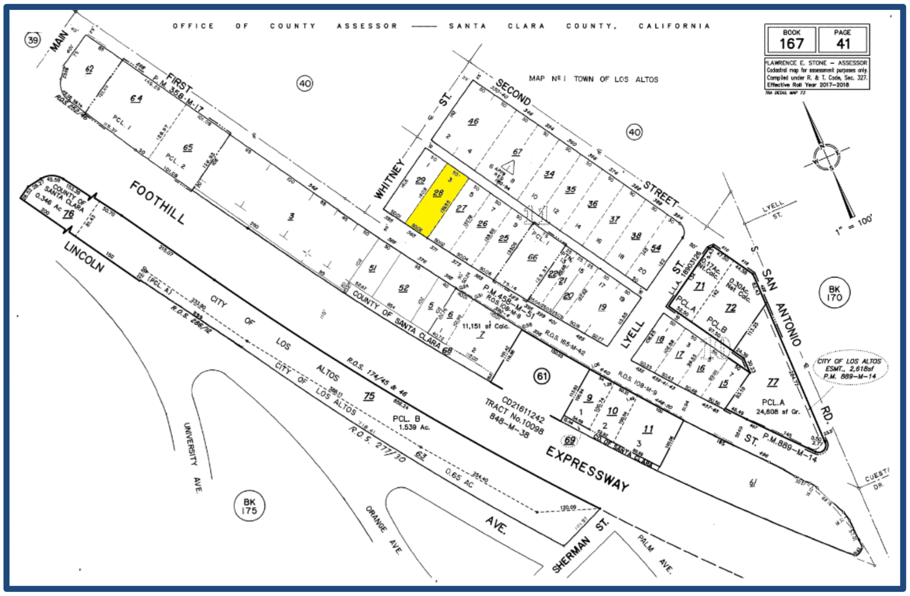
Land Sales Summary

Comp. No.	Date of Sale	Usable Acres	Location		Zoning	Proposed Use	Density Du/ac	Sales Price Actual	Per Sq. Ft.
1	October-19	0.160	365 First Street	Los Altos, California	CD/ R3	Mixed-Use Land	12.49	$3,500,000	$501.79
2	July-19	0.551	745 Distel Drive	Los Altos, California	OA-1CT	Multi-family Residential	N/A	$4,700,000	$195.83
3	June-19	0.126	440 First Street	Los Altos, California	CD/R3	Multifamily Residential	55.49	$3,300,000	$600.55
4	November-18	0.350	444-450 First Street	Los Altos, California	CD/R3	Condo Project	74.26	$7,500,000	$491.74
5	August-18	0.840	4896 El Camino Real	Los Altos, California	CT	Mixed-Use Building	33.32	$11,700,000	$319.67
6	June-18	0.271	425 1st Street	Los Altos, California	CD/R-3	Multi-family Residential	73.83	$5,700,000	$483.05
7	April-18	3.796	5150 El Camino Real	Los Altos, California	CT	Residential Development	51.63	$48,000,000	$290.26
8	January-17	0.224	389 1st Street	Los Altos, California	CD/R3	Hold for future redevelopment	26.81	$3,515,000	$360.51
9	September-17	0.650	555 S El Monte Ave	Los Altos, California		Two lot subdivision	3.08	$3,600,000	$127.15
10	November-16	0.550	209 Portola Court	Los Altos, California	R1-10	Two lot subdivision	3.64	$4,500,200	$187.84
11	February-18	0.460	961 Lundy Lane	Los Altos, California	R1	SFR Lot	N/A	$2,960,000	$147.72

LOS ALTOS COMPARABLE SALES MAP



Land Comparable 1



Property Identification

Property/Sale ID	10780058/1468262
Property Type	Mixed Use Land
Address	365 First Street
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.376130/-122.116162
Tax ID	167-41-028

Transaction Data

Sale Date	October 2019	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	24370187
Grantor	Robert Perruso Trust	**Sale Price**	$3,500,000
Grantee	Liem Nguyen		

Property Description

Gross Acres	0.16	**Use Designation**	Downtown Commercial
Gross SF	6,975	**Zoning Jurisdiction**	City of Los Altos
No. of Units	2	**Zoning Code**	CD/ R3
Density (Units/Ac)	12.49	**Zoning Description**	Commercial Downtown/ Multifamily Residential
Corner/Interior	Interior		
Shape	Rectangular		

Indicators

$/Gross Acre	$21,858,606.00	**$/Unit**	$1,750,000
$/Gross SF	$501.80		

Remarks

The property consists of a single parcel improved with a multi-tenant retail building located east of First Street in Downtown Los Altos. The parcel has a rectangular shape and an interior lot configuration with approximately 50 feet of frontage along First Street with a depth of 140 feet. An alley runs adjacent to the property, providing access to the site's rear parking lot, although parking is limited within the area. The site's downtown location is conveniently less than a mile from Foothill Expressway and approximately 1.5 miles from Interstate 280.

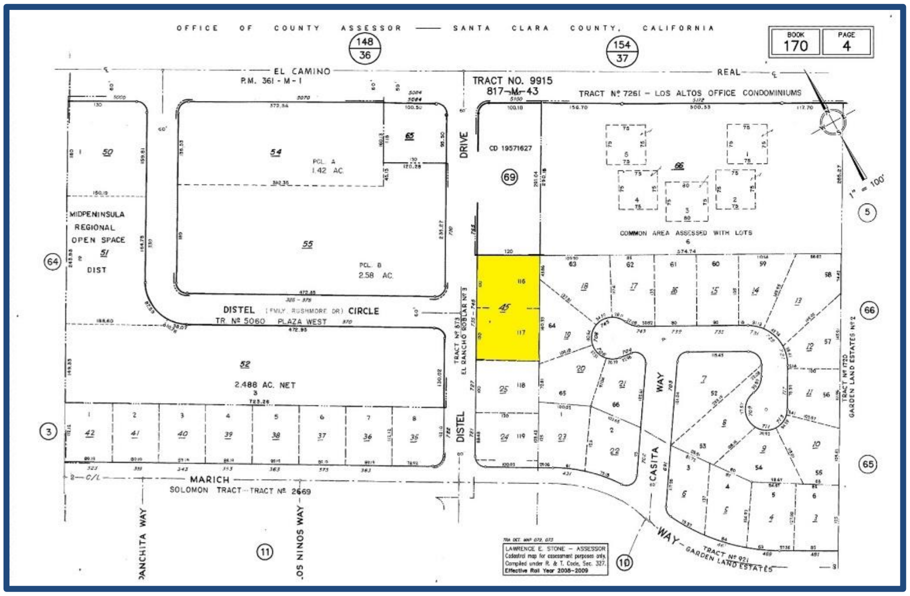
The underlying site measures approximately 6,975 square feet or 0.16 acres. Under the jurisdiction of the City of Los Altos, the property is zoned Commercial Downtown/ Multifamily Residential (CD/R3) and has a General Plan designation of Downtown Commercial. The site is surrounded by a diverse mix of retailers and single family homes.

Constructed in 1938, the retail building had below-average functional utility, significant deferred maintenance, and a dated appearance. The value, therefore, was clearly in the land, and the property was marketed as a redevelopment opportunity.

The buyer of the property is the adjacent owner who intends to assemble and redevelop the site. He is considering a mixed-use project with residential uses on upper floors. The property was listed on the market for sale at $3,100,000 for two months and had two offers both of which were above market.

Valbridge PROPERTY ADVISORS

LAND COMPARABLE 2



Property Identification

Property/Sale ID	10985430/1426664
Property Type	Commercial
Address	745 Distel Drive
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.395130/-122.103760
Tax ID	170-04-045

Transaction Data

Sale Date	July 2019	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	24241101
Grantor	Kim N. Bakke	**Sale Price**	$4,700,000
Grantee	DD 5150 ECR Partners LLC		

Property Description

Gross Acres	0.55	**Shape**	Rectangular
Gross SF	24,000	**Use Designation**	Thoroughfare Commercial
No. of Units	N/A	**Zoning Jurisdiction**	City of Los Altos
Density (Units/Ac)	N/A	**Zoning Code**	OA-1CT
Corner/Interior	Interior	**Zoning Description**	Office Administrative

Indicators

$/Gross Acre	$8,530,565.00	**$/Unit**	N/A
$/Gross SF	$195.83		

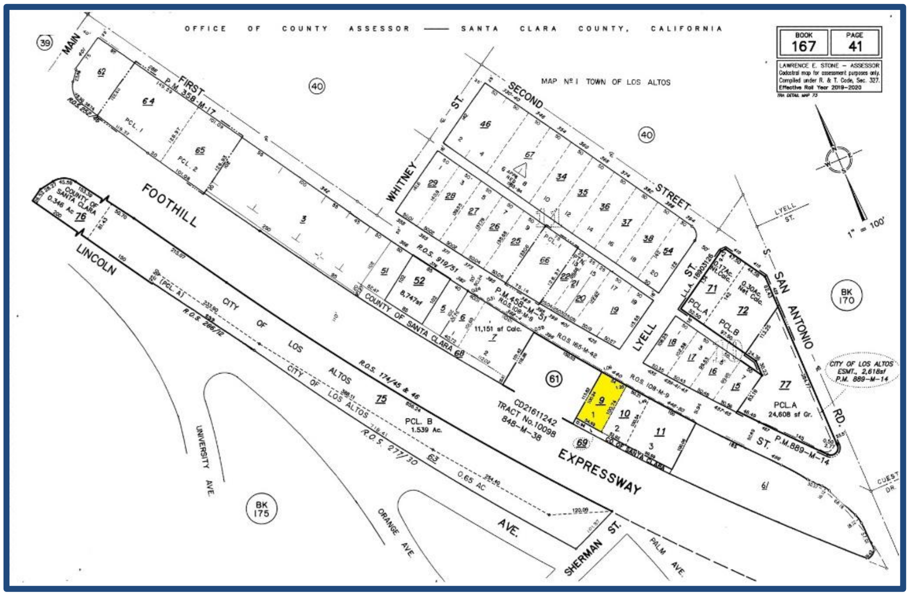
Remarks

This property consists of a single parcel improved with an office building located along the east side of Distel Drive in Los Altos. The site has a rectangular shape and a T-intersection lot configuration one parcel south of El Camino Real and across from Distel Circle. The site has approximately 200 feet of frontage along Distel Drive (with two curb cuts) and an average depth of 120 feet.

The underlying site contains 24,000 square feet or 0.55 acres. The existing improvements contain 8,676 square feet and were originally constructed circa 1963. The property zoning is Office Administrative, and the General Plan land use designation is Thoroughfare Commercial.

DD 5150 ECR Partners LLC purchased this property in July 2019 from Kim N. Bakke. This property sold for $4,700,000 or approximately $195.83 per square foot of land. The property sold below the asking price of $6,500,000 and was exposed to the market for 236 days. The property sold without entitlements. There is a deed restriction limiting redevelopment to office; however, the buyer expressed interest in redeveloping the site with residential and will seek to have the deed restriction removed. The buyer also owns the adjacent parcel to the north developed with multifamily residential uses.

Land Comparable 3



Property Identification

Property/Sale ID	10985113/1426423
Property Type	Multi-Family
Address	440 First Street
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.374876/-122.115719
Tax ID	167-41-009

Transaction Data

Sale Date	June 2019	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	24213237
Grantor	Echerd Family Trust	**Sale Price**	$3,300,000
Grantee	Bourgan Family Trust		

Property Description

Gross Acres	0.13	**Use Designation**	Downtown Commercial
Gross SF	5,495	**Zoning Jurisdiction**	City of Los Altos
No. of Units	7	**Zoning Code**	CD/R3
Density (Units/Ac)	55.49	**Zoning Description**	Commercial Downtown/Multiple Family
Corner/Interior	Interior		
Shape	Rectangular		

Indicators

$/Gross Acre	$26,159,334.00	**$/Unit**	$471,429
$/Gross SF	$600.54		

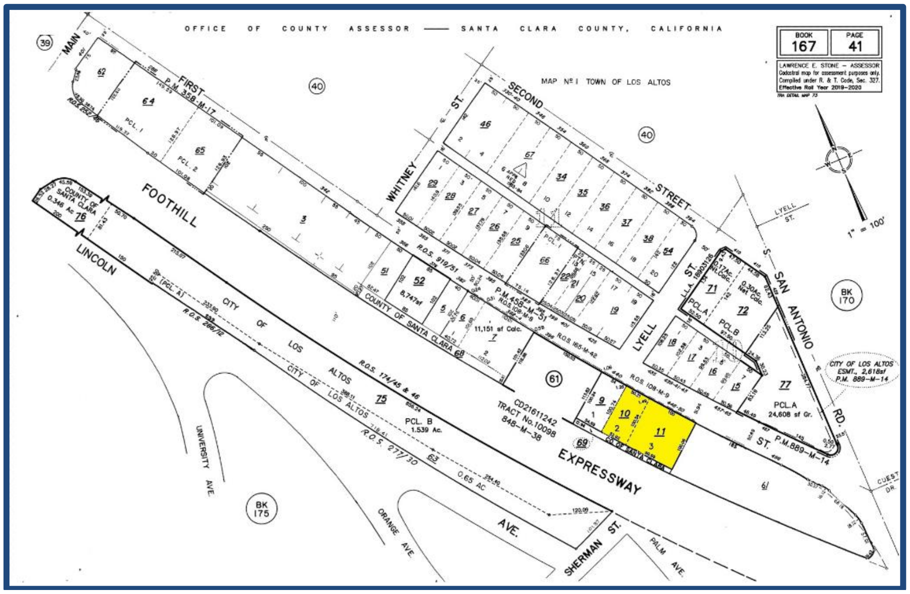
Remarks

This property consists of a parcel improved with a single-story medical office building located in downtown Los Altos. The site has a rectangular shape and an interior lot configuration with approximately 54 feet of frontage along First Street and a depth of 95 feet. The property benefits from its downtown location and nearby commercial uses.

The underlying site contains approximately 5,495 square feet or 0.13 acres. The improvements were constructed in 1980. The property is zoned Commercial Downtown/ Multiple Family, and the General Plan land use designation is Downtown Commercial.

This property sold for $3,300,000 or approximately $600 per square foot of land area. The buyer is a developer who intends on redeveloping the site with a residential condominium project. The buyer paid cash, and there were no entitlements in place at the time of sale. The buyer had, however, submitted plans for the development of a four-story, 7-unit, multi-family building with one level of underground parking. However, significant work was needed until project approval.

LAND COMPARABLE 4



Property Identification

Property/Sale ID	10985111/1426420
Property Type	Multi-Family
Address	444-450 First Street
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.374769/-122.115429
Tax ID	167-41-010 and 167-41-011

Transaction Data

Sale Date	November 2018	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	24066419
Grantor	Los Altos Fields LLC	**Sale Price**	$7,500,000
Grantee	DD 1st Street Group LLC		

Property Description

Gross Acres	0.35	**Use Designation**	Downtown Commercial
Gross SF	15,252	**Zoning Jurisdiction**	City of Los Altos
No. of Units	26	**Zoning Code**	CD/R3
Density (Units/Ac)	74.26	**Zoning Description**	Commercial Downtown/Multiple Family
Corner/Interior	Interior		
Shape	Rectangular		

Indicators

$/Gross Acre	$21,420,003.00	**$/Unit**	$288,462
$/Gross SF	$491.74		

Remarks

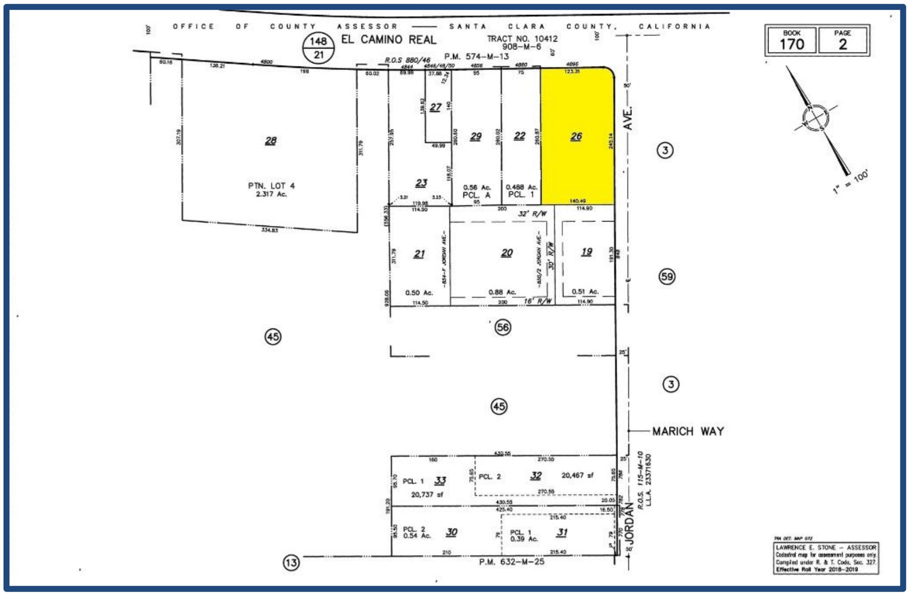
This property consists of two contiguous parcels improved with a partial two-story, multi-tenant office building located in downtown Los Altos. The site has a rectangular shape and an interior lot configuration with approximately 153 feet of frontage along First Street and a depth of 95 feet. The property benefits from its downtown location and nearby commercial uses.

The underlying site contains approximately 15,252 square feet or 0.35 acres. The site is improved with two office buildings constructed in 1957. The property is zoned Commercial Downtown/ Multiple Family, and the General Plan land use designation is Downtown Commercial.

The combined site sold for $7,500,000 or approximately $492 per square foot of land area. The buyer is a developer who intends to redevelop the site with a four-story multi-family (26 units) residential condominium project. The buyer paid cash, and there were no entitlements in place at the time of sale.

The improvements were leased at the time of sale and generated some interim income, until entitlements were received for redevelopment. The value was, however, in the land.

LAND COMPARABLE 5



Property Identification

Property/Sale ID	10720536/1426425
Property Type	Commercial
Address	4896 El Camino Real
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.398364/-122.108809
Tax ID	170-02-026

Transaction Data

Sale Date	August 2018	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	24000141
Grantor	Rielli Cecile 1990 Trust	**Sale Price**	$11,700,000
Grantee	Doheny-Vidovich Partners/De Anza Properties		

Property Description

Gross Acres	0.84	**Shape**	Rectangular
Gross SF	36,600	**Use Designation**	Thoroughfare Commercial
No. of Units	28	**Zoning Jurisdiction**	City of Los Altos
Density (Units/Ac)	33.32	**Zoning Code**	CT
Corner/Interior	Corner	**Zoning Description**	Commercial Thoroughfare

Indicators

$/Gross Acre	$13,924,924.00	**$/Unit**	$417,857
$/Gross SF	$319.67		

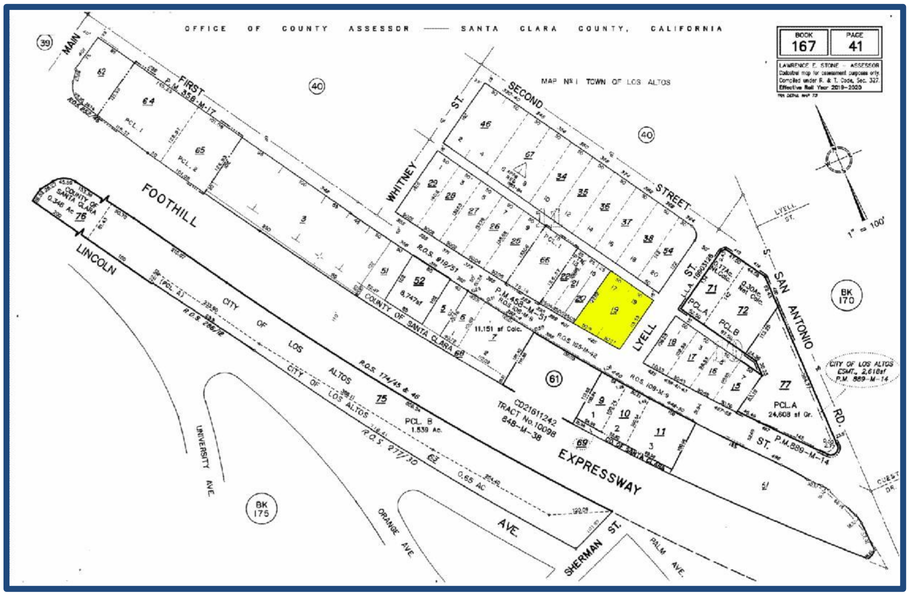
Remarks

This property consists of a single parcel improved with a fast food restaurant (Jack in the Box) and a single-family residence located along the south side of West El Camino Real in Los Altos. The site has a rectangular shape and a corner lot configuration at the signalized intersection of West El Camino Real and Jordan Avenue. The site has approximately 140 feet of frontage along West El Camino Real (with two curb cuts) and 260 feet of frontage along Jordan Avenue (with two curb cuts).

The underlying site contains 36,600 square feet or 0.84 acres. The improvements were originally constructed circa 1968. The property zoning is Commercial Thoroughfare, and the General Plan land use designation is Thoroughfare Commercial.

Doheny-Vidovich Partners/De Anza Properties purchased this property in August 2018 from Rielli Cecile 1990 Trust. The sale price was $11,700,000 or approximately $320 per square foot of land. The property sold above the asking price of $11,500,000 and was exposed to the market for 38 days. The property sold without entitlements, and the buyer intends on redeveloping the site with a four-story mixed-use building with three floors of office and four residential condo units on the 4th floor.

LAND COMPARABLE 6



Property Identification

Property/Sale ID	10780965/1425211
Property Type	Planned Development (PUD)
Address	425 1st Street
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.375270/-122.115408
Tax ID	167-41-019

Transaction Data

Sale Date	June 2018	**Property Rights**	Leased Fee
Sale Status	Recorded	**Recording Number**	23956278
Grantor	Los Altos Fields LLC	**Sale Price**	$5,700,000
Grantee	425 First Los Altos LLC		

Property Description

Gross Acres	0.27	**Use Designation**	Downtown Commercial
Gross SF	11,800	**Zoning Jurisdiction**	City of Los Altos
No. of Units	20	**Zoning Code**	CD/R-3
Density (Units/Ac)	73.83	**Zoning Description**	Commercial Downtown/Multiple Family
Corner/Interior	Corner		
Shape	Irregular		

Indicators

$/Gross Acre	$21,041,751.00	**$/Unit**	$285,000
$/Gross SF	$483.05		

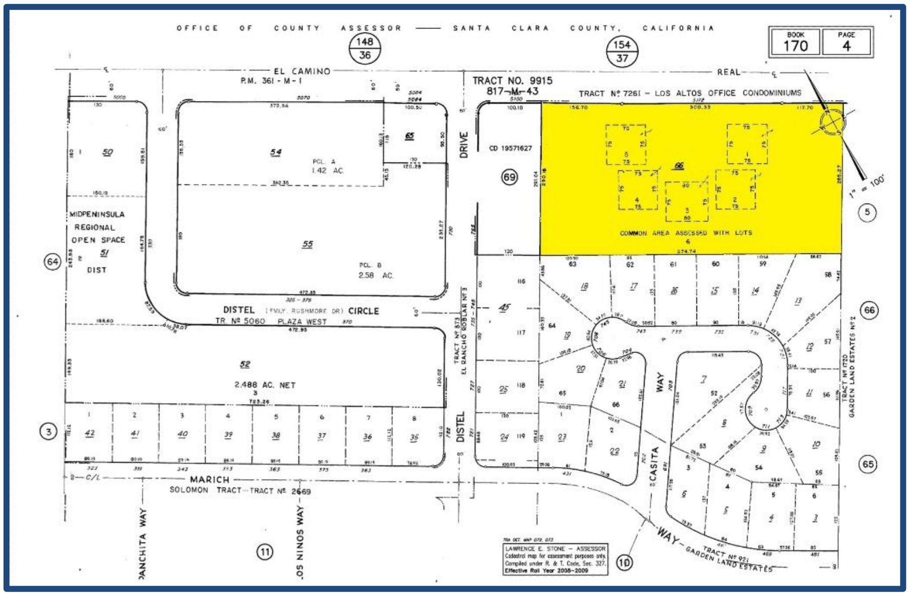
Remarks

This is an irregularly-shaped corner parcel located in Downtown Los Altos. The site measures 11,800 square feet or 0.27 acres. The improvements consist of a two-story office building with a gross building area of 4,913 square feet and net rentable area of 4,722 square feet. The building was constructed in 1975 and appears to be in adequate condition. The improvements represent a floor area ratio of 42%. However, the value of these improvements was interim, until entitlements are received for redevelopment.

This property sold for $5,700,000 or approximately $337 per square foot of site area. The property was reportedly 29% occupied at the time of sale by one tenant with a lease through December 2020. The buyer intended on occupying the remaining ground-floor unit, and eventually redevelop in 2020. The buyer put $2.7M down and financed the remainder through Technology Credit Union.

In June of 2019 the site received entitlements for a new three-story, 20-unit multi-family building with one level of underground parking. The project will provide three affordable units but did not seek any development incentives.

LAND COMPARABLE 7



Property Identification

Property/Sale ID	10994571/1432450
Property Type	Mixed Use Land
Address	5150 El Camino Real
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.395271/-122.102275
Tax ID	170-04-066

Transaction Data

Sale Date	April 2018	**Grantee**	Dutchints Development (5150 ECR Group LLC)
Sale Status	Recorded		
Grantor	Realty Associates Fund X LP	**Property Rights**	Leased Fee
		Recording Number	23910566
		Sale Price	$48,000,000

Property Description

Gross Acres	3.80	**Shape**	Rectangular
Gross SF	165,367	**Use Designation**	Thoroughfare Commercial
No. of Units	196	**Zoning Jurisdiction**	City of Mountain View
Density (Units/Ac)	51.63	**Zoning Code**	CT
Corner/Interior	Interior	**Zoning Description**	Commercial Thoroughfare

Indicators

$/Gross Acre	$12,643,890.00	**$/Unit**	$244,898
$/Gross SF	$290.26		

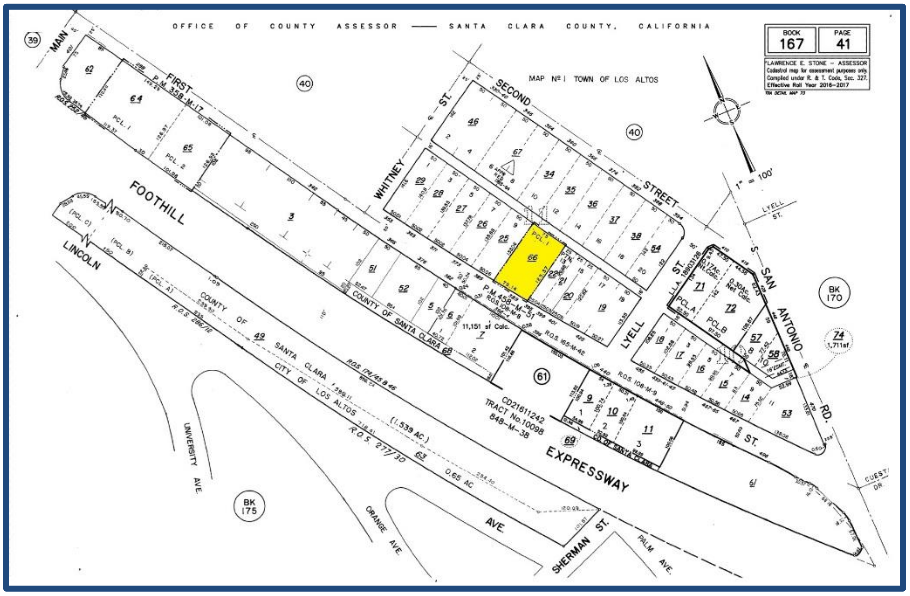
Remarks

This property consists of a single parcel improved with a three-story, multi-tenant, office building located along the south side of West El Camino Real in Los Altos. The site has a rectangular shape and a T-intersection lot configuration at the signalized intersection of West El Camino Real and South Rengstorff Avenue. The site has approximately 575 feet of frontage along West El Camino Real and an average depth of 290 feet. The property has visibility along a commercial thoroughfare and direct access from a signalized intersection.

The underlying site measures 165,367 gross square feet or 3.80 gross acres. The existing improvements contain 76,525 square feet and were constructed circa 1982. The floor area ratio is 46%. The property zoning is Commercial Thoroughfare, and the General Plan land use designation is Thoroughfare Commercial. The land use designation allows mixed-use development up to 1.5 FAR along the El Camino Real Corridor.

Dutchints Development purchased this property in April 2018 from Realty Associates Fund X LP. The sale price was $48,000,000 or $290 per square foot of site area. This was an off-market transaction. Although the asking/ sale price was based on the existing office NOI, the buyer is a home-builder who sees future high-density residential redevelopment for the site, upon receipt of entitlements.

LAND COMPARABLE 8



Property Identification

Property/Sale ID	10777228/1318422
Property Type	Mixed Use Land
Address	389 1st Street
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.375602/-122.115744
Tax ID	167-41-066

Transaction Data

Sale Date	January 2017	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	23590261
Grantor	Sandridge Trust	**Sale Price**	$3,515,000
Grantee	1st Place Village, LLC		

Property Description

Gross Acres	0.22	**Use Designation**	Downtown Commercial
Gross SF	9,750	**Zoning Jurisdiction**	City of Los Altos
No. of Units	6	**Zoning Code**	CD/R3
Density (Units/Ac)	26.81	**Zoning Description**	Commercial Downtown/ Multiple Family
Corner/Interior	Interior		
Shape	Generally Rectangular		

Indicators

$/Gross Acre	$15,703,882.00	**$/Unit**	$585,833
$/Gross SF	$360.51		

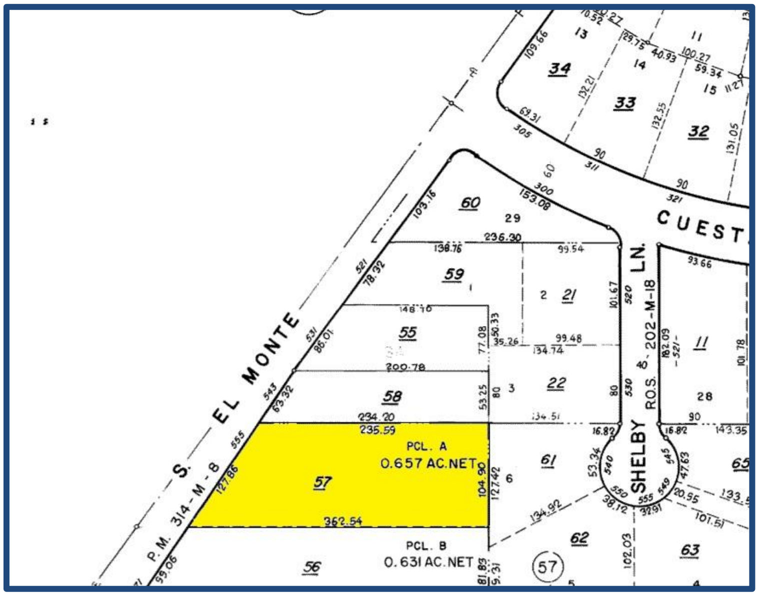
Remarks

This property consists of a single parcel improved with two contiguous commercial buildings located along the northeast side of 1st Street in downtown Los Altos. The site has a generally rectangular shape with approximately 75 feet of frontage along 1st Street and an average depth of 130 feet. There is an alleyway which runs along the rear of the property and connects Lyell Street and Whitney Street. The property benefits from its downtown Los Altos location.

The underlying site measures 9,750 gross square feet or 0.22 gross acres. The improvements contain approximately 3,140 square feet, were constructed circa 1980, and are demised into two retail units and one office unit. The floor area ratio is 32%. The property is zoned Commercial Downtown/ Multiple Family, and the General Plan land use designation is Downtown Commercial. The property sold fully leased with long-term tenants on month-to-month leases.

1st Place Village, LLC purchased this property in February 2017 from Sandridge Trust. The property sold below the asking price of $2,500,000. The sale price was $3,515,000 or $360.51 per square foot of land. The buyer is a tenant who will continue to occupy a portion of the property. His eventual plans are, however, to redevelop the property in the future. The site received entitlements along with the adjacent 385 First Street site for the development of 10 condo units over 2,800 square feet of office in July of 2019. There will also be a one level ground garage with a mechanical lift system and a rooftop deck. The project received development incentives for increased height in exchange of providing one affordable unit. We estimate that 6 of the units will be located on this portion of the assembled site, based on the project density of 27 du/ac.

LAND COMPARABLE 9



Property Identification

Property/Sale ID	10782488/1321407
Property Type	Subdivision-Residential
Address	555 S El Monte Avenue
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.373055/-122.107909
Tax ID	189-51-057

Transaction Data

Sale Date	September 2017	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	0023766123
Grantor	Padori Trust	**Sale Price**	$3,600,000
Grantee	Bauhaus LLC		

Property Description

Gross Acres	0.65	**Use Designation**	Single-Family Medium Lot (SF-4)
Gross SF	28,314		
No. of Units	2	**Zoning Jurisdiction**	City of Los Altos
Density (Units/Ac)	3.08	**Zoning Code**	R1-10
Corner/Interior	Interior	**Zoning Description**	Single-Family
Shape	Trapezoidal		

Indicators

$/Gross Acre	$5,538,462.00	**$/Unit**	$1,800,000
$/Gross SF	$127.15		

Remarks

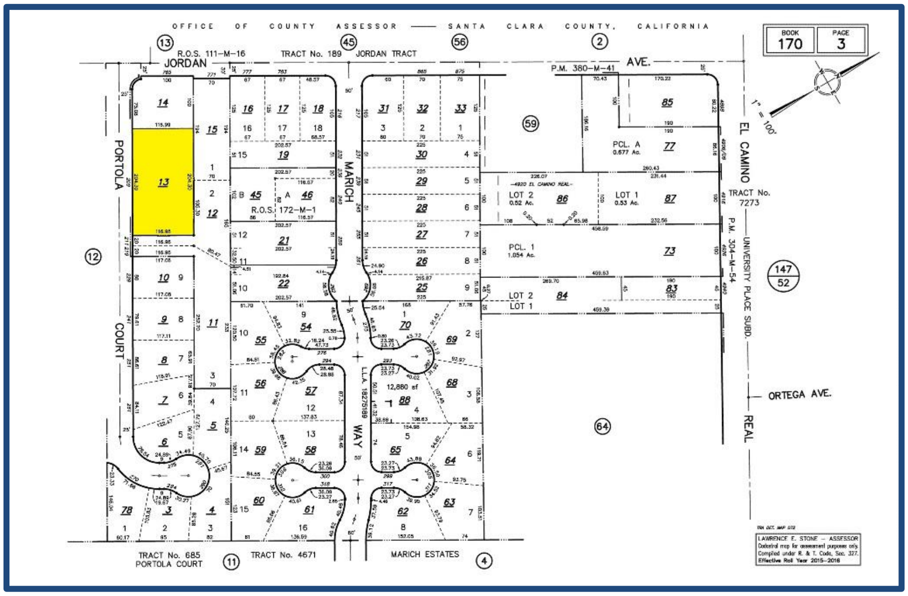
The property consists of a single parcel improved with an older single-family residence located northeast of the intersection of Foothill Expressway and El Monte Avenue in Los Altos. The site is composed of two legal lots with an interior lot configuration. The parcel has approximately 128 feet of frontage along a divided portion of El Monte Avenue, which restricts the flow of traffic one-way north from the property. Foothill Expressway is approximately half a mile west, which connects to Interstate 280 approximately 3.6 miles west of the property. Downtown Los Altos is conveniently located less than 2 miles north.

The underlying site measures 28,314 gross square feet or 0.65 acres. Under the jurisdiction of the City of Los Altos, the site has a zoning of R1-10, or Single Family, and a General Plan land use designation of Single-Family Medium Lot (SF-4), which permits a maximum density of 4 dwelling units per net acre.

The single-family home was built circa 1907 and was of little to no value. The value was in the land for subdivision and redevelopment.

Padori Trust purchased this property from Bauhaus LLC in September 2017. The property was listed for a week and sold above the asking price of $3,250,000.

LAND COMPARABLE 10



Property Identification

Property/Sale ID	10777164/1318383
Property Type	Subdivision-Residential
Address	209 Portola Court
City, State Zip	Los Altos, California 94022
County	Santa Clara
Latitude/Longitude	37.395607/-122.109524
Tax ID	170-03-013

Transaction Data

Sale Date	November 2016	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	23538288
Grantor	Emerich Barbara Trust	**Sale Price**	$4,500,200
Grantee	HAQQ Family Trust | Bourgan Family Trust		

Property Description

Gross Acres	0.55	**Use Designation**	Single Family, Small Lot (4 du/ac)
Gross SF	23,958		
No. of Units	2	**Zoning Jurisdiction**	City of Los Altos
Density (Units/Ac)	3.64	**Zoning Code**	R1-10
Corner/Interior	Interior	**Zoning Description**	Single-Family
Shape	Rectangular		

Indicators

$/Gross Acre	$8,182,182.00	**$/Unit**	$2,250,100
$/Gross SF	$187.84		

Remarks

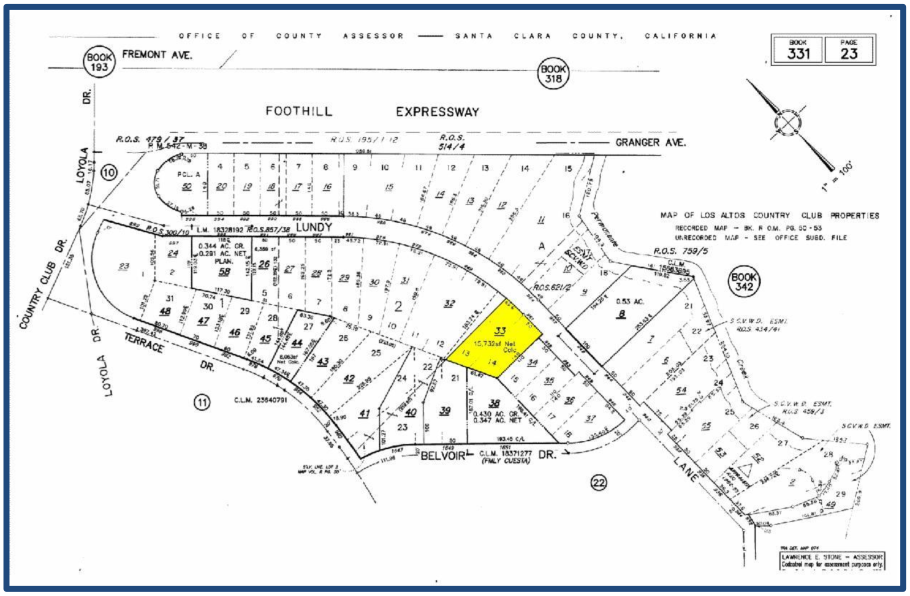
This property consists of a single parcel improved with an older single-family residence located along the north side of Portola Court in Los Altos. The site has a rectangular shape and an interior lot configuration one parcel east of Jordan Avenue. The site has approximately 205 feet of frontage along Portola Court and a depth of 120 feet.

The underlying site measures approximately 23,958 gross square feet or 0.55 gross acres. The improvements contain approximately 2,510 square feet and were original constructed in the early 1900s. The property zoning and General Plan land use designation are Single-Family Residential. The land has subdivision potential for up to two lots.

The property was marketed for land value at $3,988,000 and received four offers and sold to the highest bidder. The listing agent stated that the Thanksgiving holiday and the aftermath of the presidential election were influential to the sale of the property, as people were discovering belatedly that the property was on the market, and developers were having trouble rounding up investors. The property could be subdivided into two lots and the buyer of the property intends to use one of the two lots and sell the other. The buyer was working with a developer for constructing a home, and the buyer's agent had a very strong relationship with the buyer and a lot of experience with Los Altos development. Her guidance and reputation, along with financial connections, made their offer the highest. They did obtain financing; it was not a cash sale.

At the time of sale, the house was occupied; there was a 4-month free rent back period for family members who were living there. Since the time of the sale, the property has been subdivided into two parcels, which was the maximum allowed by the city.

LAND COMPARABLE 11



Property Identification

Property/Sale ID	11017207/1468416
Property Type	Residential (Single-Family)
Address	961 Lundy Lane
City, State Zip	Los Altos, California 94024
County	Santa Clara
Latitude/Longitude	37.350301/-122.086957
Tax ID	331-23-033

Transaction Data

Sale Date	February 2018	**Property Rights**	Fee Simple
Sale Status	Recorded	**Recording Number**	0023880074
Grantor	Jo Alida Wilcox	**Sale Price**	$2,960,000
Grantee	West Valley Ventures LLC		

Property Description

Gross Acres	0.46	**Use Designation**	Single-Family Medium Lot (SF-4)
Gross SF	20,038		
No. of Units	1	**Zoning Jurisdiction**	City of Los Altos
Density (Units/Ac)	2.17	**Zoning Code**	R1-10
Corner/Interior	Interior	**Zoning Description**	Single-Family
Shape	Trapezoidal		

Indicators

$/Gross Acre	$6,434,783.00	**$/Unit**	$2,960,000
$/Gross SF	$147.72		

Remarks

The property consists of one parcel improved with a single-family home located west of Foothill Expressway in Loyola, a census-designated place nestled between the city of Los Altos and the Los Altos Hills. The parcel has an interior lot configuration and is composed of two lots that form a trapezoidal shape. Along Lundy Avenue, the parcel has approximately 120 feet of frontage and a depth of 184 feet. The property is less than a quarter of a mile from Foothill Expressway and less than two miles from Interstate 280, providing adequate access. Both El Camino Hospital and Downtown Los Altos are within 2.5 miles north, and the property also benefits from being near the Los Altos Golf and Country Club.

The underlying site measures approximately 20,038 square feet or 0.46 gross acres, although the title company shows a slightly smaller size of 17,765 square feet or 0.4 acres to the middle of the road and the Assessor's plat map shows a net square footage of 15,732 square feet or 0.36 acres. Under the jurisdiction of the City of Los Altos, the site has a zoning of R1-10, or Single Family, and a General Plan land use designation of Single-Family Medium Lot (SF-4), which permits a maximum density of 4 dwelling units per net acre.

The site is improved with a single-family home originally constructed in 1944 and in fair condition. The home was expanded by the owner in the past, but it is unclear if the expansion was approved. The property's value is in the land.

The property sold in March 2018 for a reported $2,960,000 and involved a conventional loan of $2,368,000. The buyer, West Valley Ventures LLC, is a luxury home builder who is planning a 6,000-square-foot home onsite.

Summary of Los Altos Residential Land Values

The residential land sales presented above bracket a variety of locations within Los Altos, densities, sizes, project types and other physical characteristics. Overall, they bracket current residential land values in Los Altos well.

The purpose of this assignment is to provide a range of values for vacant, unentitled, residential land in Los Altos. The comparable sales bracket current residential land values in Los Altos. We have adjusted the sales for interim income and other factors that affect the sale price, so that the final range concluded represents current, unentitled land values.

Comparable 1 was downward adjusted for being an assemblage. The price paid was believed to be slightly above market. Comparable 8 was purchased by the tenant while Comparable 10 was purchased by a very motivated buyer. Both comparables also warrant a downward adjustment under conditions of sale. On the other hand, Comparable 7 was considered a below market sale, given that it was an off-market transaction, and an upward adjustment was made.

As noted earlier, market conditions started to stabilize over the past year for the residential market. In Los Altos, home prices have shown a small decline, especially for the Single-Family Detached product. Condo prices have remained stable or have slightly increased in the past year. We note, however, that the land market is still very active and several transactions took place over the past two years. These sales demonstrate high land values, particularly in the downtown area. Our adjustment for current market conditions is based on an approximately annual increase of 5% per year. Each of the sales was adjusted accordingly, to reflect current market conditions.

All of the comparables were purchased for residential development. While some of the comparable sales were located along major commercial thoroughfares, and within zoning districts that encouraged mixed-use development, the buyers' intentions were to develop the sites residentially. The only exception was Comparable 5, planned for a mixed-use project. However, an adjustment for the proposed mixed-use development was not supported. Thus, no adjustment was warranted.

Comparable 2 had inferior Office zoning and general plan. While the buyer intends to develop the site residentially, he would have to proceed with a zoning change and a general plan amendment, a discretionary process with uncertain outcome. Considering that office land commands lower prices than residential land, an upward adjustment for zoning was supported.
All of the comparable sales were unentitled land sales and no adjustments were warranted in this category. However, partial entitlements were in place for Comparable 2, and as such it required a downward adjustment in this category.

Comparables 1, 2, 4, 6, 7 and 8 had improvements on site that were either attributed some value or contributed interim income; this interim income could carry the properties through the entitlements process. A downward adjustment was made to these comparables. Comparable 2 was encumbered with a deed restriction that presented uncertainty. We have made an upward adjustment to this comparable, in account of the risk associated with redevelopment.

No other adjustments were made to the sales. After these adjustments, the sales reflect a broad range of current, unentitled land values in Los Altos.

The adjustments made to the sales are summarized in the adjustment grid on the following page. We note that the adjustment grid is not intended to be a scientific method in adjusting the land sales. It is merely presented as an explanation to help the reader follow the appraiser's judgment and the adjustment process. While the amount of individual adjustments can be argued, they do help provide an order of magnitude and an adjustment direction based on the market data presented.

Land Sales Adjustment Grid

	Subject	Sale # 1	Sale # 2	Sale # 3	Sale # 4	Sale # 5	Sale # 6	Sale # 7	Sale # 8	Sale # 9	Sale # 10	Sale # 11
Sale ID		1468262	1426664	1426423	1426420	1426425	1425211	1432450	1318422	1321407	1318383	1468416
Date of Value & Sale	January-20	October-19	July-19	June-19	November-18	August-18	June-18	April-18	January-17	September-17	November-16	February-18
Unadjusted Sales Price		$3,500,000	$4,700,000	$3,300,000	$7,500,000	$11,700,000	$5,700,000	$48,000,000	$3,515,000	$3,600,000	$4,500,200	$2,960,000
Usable Acres	0.000	0.160	0.551	0.126	0.350	0.840	0.271	3.796	0.224	0.650	0.550	0.460
Unadjusted Sales Price per Usable Sq. Ft.		**$501.79**	**$195.83**	**$600.55**	**$491.74**	**$319.67**	**$483.05**	**$290.26**	**$360.51**	**$127.15**	**$187.84**	**$147.72**
Transactional Adjustments												
Property Rights Conveyed	*Fee Simple*	*Fee Simple*	*Fee Simple*	*Fee Simple*	*Fee Simple*	*Fee Simple*	*Leased Fee*	*Leased Fee*	*Fee Simple*	*Fee Simple*	*Fee Simple*	*Fee Simple*
Adjustment		-	-	-	-	-	-	-	-	-	-	-
Adjusted Sales Price		$501.79	$195.83	$600.55	$491.74	$319.67	$483.05	$290.26	$360.51	$127.15	$187.84	$147.72
Financing Terms	*Cash to Seller*	*Conventional*	*Conventional*	*Cash*	*Cash*	*Conventional*	*Conventional*	*Conventional*	*Conventional*	*Cash*	*Conventional*	*Cash*
Adjustment		-	-	-	-	-	-	-	-	-	-	-
Adjusted Sales Price		$501.79	$195.83	$600.55	$491.74	$319.67	$483.05	$290.26	$360.51	$127.15	$187.84	$147.72
Conditions of Sale	*Typical*	*Assemblage*	*Typical*			*Typical*	*Typical*	*Off market transaction*	*Purchased by tenant*		*Motivated*	
Adjustment		-10.0%	-	-	-	-	-	10.0%	-10.0%	-	-10.0%	-
Adjusted Sales Price		$451.61	$195.83	$600.55	$491.74	$319.67	$483.05	$319.29	$324.46	$127.15	$169.05	$147.72
Expenditures after Sale												
Adjustment		-	-	-	-	-	-	-	-	-	-	-
Adjusted Sales Price		**$451.61**	**$195.83**	**$600.55**	**$491.74**	**$319.67**	**$483.05**	**$319.29**	**$324.46**	**$127.15**	**$169.05**	**$147.72**
Market Conditions Adjustments												
Elapsed Time from Date of Value		*0.25 years*	*0.53 years*	*0.61 years*	*1.19 years*	*1.48 years*	*1.62 years*	*1.79 years*	*3.04 years*	*2.35 years*	*3.16 years*	*1.96 years*
Market Trend Through	January-20	1.3%	2.6%	3.0%	6.0%	7.4%	8.1%	8.9%	15.2%	11.8%	15.8%	9.8%
Analyzed Sales Price		**$457.30**	**$201.01**	**$618.73**	**$521.04**	**$343.28**	**$522.22**	**$347.81**	**$373.80**	**$142.09**	**$195.78**	**$162.17**
Physical Adjustments												
Location	*Unencumbered Residential Land Los Altos, California*	*365 First Street Los Altos, California*	*745 Distel Drive Los Altos, California*	*440 First Street Los Altos, California*	*444-450 First Street Los Altos, California*	*4896 El Camino Real Los Altos, California*	*425 1st Street Los Altos, California*	*5150 El Camino Real Los Altos, California*	*389 1st Street Los Altos, California*	*555 S El Monte Avenue Los Altos, California*	*209 Portola Court Los Altos, California*	*961 Lundy Lane Los Altos, California*
Adjustment		-	-	-	-	-	-	-	-	-	-	-
Size	*0.000 acres*	*0.160 acres*	*0.551 acres*	*0.126 acres*	*0.350 acres*	*0.840 acres*	*0.271 acres*	*3.796 acres*	*0.224 acres*	*0.650 acres*	*0.550 acres*	*0.460 acres*
Adjustment		-	-	-	-	-	-	-	-	-	-	-
Shape/Depth		*Rectangular*	*Rectangular*	*Rectangular*	*Rectangular*	*Rectangular*	*Irregular*	*Rectangular*	*Generally Rectangular*	*Trapezoid*	*Rectangular*	*Flag lot*
Adjustment		-	-	-	-	-	-	-	-	-	-	-
Topography		*Level*	*Level*	*Level*	*Level*	*Level*	*Generally level*	*Level*	*Generally Level*	*Level*	*Level*	*Level*
Adjustment		-	-	-	-	-	-	-	-	-	-	-
Zoning		*CD/ R3*	*OA-1CT*	*CD/R3*	*CD/R3*	*CT*	*CD/R-3*	*CT*	*CD/R3*	*R1*	*R1-10*	*R1*
Adjustment		-	30.0%	-	-	-	-	-	-	-	-	-
Entitlements		*No*	*No*	*Preliminary*	*No*	*No*	*No*	*No*	*No*	*No*	*No*	*No*
Adjustment		-	-	-20.0%	-	-	-	-	-	-	-	-
Other		*Interim Use*	*Deed Restriction*	*Interim use of the improvements*	*Interim Use of the Improvements*		*Interim use of the improvements*	*Interim Use*	*Interim Use*			
Adjustment		-20.0%	20.0%	-20.0%	-20.0%	-	-20.0%	-20.0%	-20.0%	-	-	-
Net Physical Adjustment		-20.0%	50.0%	-40.0%	-20.0%	-	-20.0%	-20.0%	-20.0%	-	-	-
Adjusted Sales Price per Usable Square Foot		**$365.84**	**$301.52**	**$371.24**	**$416.83**	**$343.28**	**$417.78**	**$278.25**	**$299.04**	**$142.09**	**$195.78**	**$162.17**

After adjustment, the sales indicate a range from $142 to $418 per square foot of land area, which is a very wide range. This wide range reflects a variety of other factors, such as the underlying zoning/ density of development, the specific location within Los Altos, the size of the lot etc. The average of the comparables is $299 per square foot and the median is $302 per square foot.

Land Sale Statistics

Metric	Unadjusted	Adjusted
Minimum Sales Price per Usable Square Foot	$127.15	$142.09
Maximum Sales Price per Usable Square Foot	$600.55	$417.78
Median Sales Price per Usable Square Foot	$319.67	$301.52
Mean Sales Price per Usable Square Foot	$336.92	$299.44

At the low end of the range are Comparables 9, 10 and 11. These are lower density, single family residential sites. They range in adjusted value between $142 and $196 per square foot.

The rest of the comparables were higher density sales, proposed for condo or multi-family residential(apartment) development. This is a very desirable product/ density range for most developers today. These sales ranged between $278 to $418 per square foot.

The low price paid for Comparable Sale 7 reflects the fact that this was an off-market transaction, as well as a dated sale. At the upper end of the range, Sales 3 and 5 were small lots in downtown Los Altos, where very high-density development was proposed. The rest of the sales form a tighter range of $300-$370 per square foot. We note that Comparables 1, 2 and 3 are the most recent sales in the sample. Giving more weight to these comparables, as well as the average of the comparable sales, a range of value of $300 to $350 is considered more appropriate for medium to high-density residential land.

In summary, the Los Altos sales surveyed indicate an adjusted range of $142 to $417 per square foot, which reflects the value of most vacant, unentitled residential land sites within Los Altos. Most land purchased in Los Altos is for condominium or apartment development. The value for this type of land most commonly ranges between **$300 and $350** per square foot. The value for low density residential land is in the $**150 to $190** per square foot range.

Analysis of Additional Residential Land Sales

As noted previously, we have also researched and analyzed additional land sales located in the communities surrounding Los Altos, in an effort to provide additional support for the land value ranges concluded above. These sales are summarized in the table on the next page. A location map follows. Prior to adjustment, the sales range between $133 and $305 per square foot. As with the sales located in Los Altos, they reflect a variety of physical characteristics, densities and development potential.

Land Sales Summary

Comp. No.	Date of Sale	Usable Acres	Location		Zoning	Proposed Use	Density Du/ac	Sales Price Actual	Per Sq. Ft.
1	January-19	0.654	1926-1938 Gamel Way	Mountain View, California	R3	Apartments	27.53	$6,830,000	$239.79
2	November-19	3.050	2310 Rock Street	Mountain View, California	R322	Townhomes	17.52	$40,500,000	$304.84
3	February-19	0.360	4115 El Camino Real	Palo Alto, California	CN	Mixed-Use Building	19.42	$7,650,000	$487.26
4	October-19	3.850	525 E Evelyn Avenue	Mountain View, California	P(30)	Apartment	N/A	$32,650,000	$194.69
5	March-19	0.878	410-414 Sierra Vista Avenue	Mountain View, California		Townhomes	17.09	$10,000,000	$261.53
6	September-18	0.580	715 Sleeper Avenue	Mountain View, California	R1-10	Two home subdivision	3.45	$3,350,000	$132.59

Summary of Nearby Residential Land Values

The residential land sales presented above bracket a variety of locations around Los Altos, densities, sizes, project types and other physical characteristics. Overall, they bracket current residential land values in Los Altos well.

We have adjusted the comparable sales under various categories that affect the sale price, so that the final range concluded represents current, unentitled land values reflective of the Los Altos market.

In summary, the additional sales surveyed, from the broader market area, suggest an adjusted range of value in the $156 to $322 per square foot, which reflects the value of most vacant, unentitled residential land sites within the submarket. The low end of the range is for the low density, single family residential land sale 6. This sale has an adjusted price per square foot of $156. The rest of the comparables are for medium / high density residential land and ranged between $249 and $322 per square foot. These sales drawn from the broader market area provide additional support for the value ranges indicated by the Los Altos land sales.

Conclusion of Land Value

Based on the research and analysis contained in this report, the range of current land values for vacant, unentitled land purchased in Los Altos for residential development, as of January 28, 2020, is as follows:

Value Conclusion

Component	As Is
Value Type	Market Value
Property Rights Appraised	Fee Simple
Effective Date of Value	January 28, 2020
Value Range- Sinle Family Residential	**$150-$190 per sf**
Value Range Multi-Family Residential	**$300-$350 per sf**

The above range reflects the value of most vacant, unentitled residential land sites within Los Altos. Most land purchased in Los Altos is for condominium and mixed-use development. The value for such land is between $300 to $350 per square foot, while for single family residential land in the $160-$200 per square foot. These values are generally supported by land sales drawn from surrounding cities/ broader market area.

We note that current, unentitled residential land values are dependent on a variety of factors and are specific to individual properties. The range of values reported in this report is not specific to any single piece of property in Los Altos but rather reflects a range of values expected for land purchased in Los Altos that has residential development potential. The actual value for any specific property is dependent on factors such as the ease in which entitlements can be obtained, its location, school district, size, likely development density, etc. The values reported herein bracket a variety of these factors, as reflected in the current market.

General Assumptions and Limiting Conditions

This appraisal is subject to the following general assumptions and limiting conditions:

1. No responsibility is assumed for legal matters, questions of survey or title, soil or subsoil conditions, engineering, availability or capacity of utilities, or other similar technical matters. The appraisal does not constitute a survey of the property appraised. All existing liens and encumbrances have been disregarded and the property is appraised as though free and clear, under responsible ownership and competent management unless otherwise noted.

2. Unless otherwise noted, the appraisal will value the property as though free of contamination. Valbridge Property Advisors | Northern California will conduct no hazardous materials or contamination inspection of any kind. It is recommended that the client hire an expert if the presence of hazardous materials or contamination poses any concern.

3. The stamps and/or consideration placed on deeds used to indicate sales are in correct relationship to the actual dollar amount of the transaction.

4. The appraiser is not required to give testimony or attendance in court by reason of this appraisal, unless previous arrangements have been made.

5. Unless expressly specified in the engagement letter, the fee for this appraisal does not include the attendance or giving of testimony by Appraiser at any court, regulatory or other proceedings, or any conferences or other work in preparation for such proceeding. If any partner or employee of Valbridge Property Advisors | Northern California is asked or required to appear and/or testify at any deposition, trial, or other proceeding about the preparation, conclusions or any other aspect of this assignment, client shall compensate Appraiser for the time spent by the partner or employee in appearing and/or testifying and in preparing to testify according to the Appraiser's then current hourly rate plus reimbursement of expenses.

6. The values for land and/or improvements, as contained in this report, are constituent parts of the total value reported and neither is (or are) to be used in making a summation appraisal of a combination of values created by another appraiser. Either is invalidated if so used.

7. The dates of value to which the opinions expressed in this report apply are set forth in this report. We assume no responsibility for economic or physical factors occurring at some point at a later date, which may affect the opinions stated herein. The forecasts, projections, or operating estimates contained herein are based on current market conditions and anticipated short-term supply and demand factors and are subject to change with future conditions. Appraiser is not responsible for determining whether the date of value requested by Client is appropriate for Client's intended use.

8. The information, estimates and opinions, which were obtained from sources outside of this office, are considered reliable. However, no liability for them can be assumed by the appraiser.

9. Possession of this report, or a copy thereof, does not carry with it the right of publication. Neither all, nor any part of the content of the report, or copy thereof (including conclusions as to property value, the identity of the appraisers, professional designations, reference to any professional appraisal organization or the firm with which the appraisers are connected), shall be disseminated to the public through advertising, public relations, news, sales, or other media without prior written consent and approval.

10. No claim is intended to be expressed for matters of expertise that would require specialized investigation or knowledge beyond that ordinarily employed by real estate appraisers. We claim no expertise in areas such as, but not limited to, legal, survey, structural, environmental, pest control, mechanical, etc.

11. This appraisal was prepared for the sole and exclusive use of the client for the function outlined herein. Any party who is not the client or intended user identified in the appraisal or engagement letter is not entitled to rely upon the contents of the appraisal without express written consent of Valbridge Property Advisors | Northern California and Client. The Client shall not include partners, affiliates, or relatives of the party addressed herein. The appraiser assumes no obligation, liability or accountability to any third party.

12. Distribution of this report is at the sole discretion of the client, but third-parties not listed as an intended user on the face of the appraisal or the engagement letter may not rely upon the contents of the appraisal. In no event shall client give a third-party a partial copy of the appraisal report. We will make no distribution of the report without the specific direction of the client.

13. This appraisal shall be used only for the function outlined herein, unless expressly authorized by Valbridge Property Advisors | Northern California.

14. This appraisal shall be considered in its entirety. No part thereof shall be used separately or out of context.

15. Unless otherwise noted in the body of this report, this appraisal assumes that the subject property does not fall within the areas where mandatory flood insurance is effective. Unless otherwise noted, we have not completed nor have we contracted to have completed an investigation to identify and/or quantify the presence of non-tidal wetland conditions on the subject property. Because the appraiser is not a surveyor, he or she makes no guarantees, express or implied, regarding this determination.

16. It is assumed that there are no hidden or unapparent conditions of the property, subsoil, or structures which would render it more or less valuable. No responsibility is assumed for such conditions or for engineering which may be required to discover them.

17. This appraisal does not guarantee compliance with building code and life safety code requirements of the local jurisdiction. It is assumed that all required licenses, consents, certificates of occupancy or other legislative or administrative authority from any local, state or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value conclusion contained in this report is based unless specifically stated to the contrary.

18. We have attempted to reconcile sources of data discovered or provided during the appraisal process, including assessment department data. Ultimately, the measurements that are deemed by us to be the most accurate and/or reliable are used within this report. While the measurements and any accompanying sketches are considered to be reasonably accurate and reliable, we cannot guarantee their accuracy. Should the client desire more precise measurement, they are urged to retain the measurement services of a qualified professional (space planner, architect or building engineer) as an alternative source. If this alternative measurement source reflects or reveals substantial differences with the measurements used within the report, upon request of the client, the appraiser will submit a revised report for an additional fee.

19. Unless otherwise stated in this report, the value conclusion is predicated on the assumption that the property is free of contamination, environmental impairment or hazardous materials. Unless otherwise stated, the existence of hazardous material was not observed by the appraiser and the appraiser has no knowledge of the existence of such materials on or in the property. The appraiser, however, is not qualified to detect such substances. The presence of substances such as asbestos, urea-formaldehyde foam insulation or other potentially hazardous materials may affect the value of the property. No responsibility is assumed for any such conditions, or for any expertise or engineering knowledge required for discovery. The client is urged to retain an expert in this field, if desired.

20. No changes in any federal, state or local laws, regulations or codes (including, without limitation, the Internal Revenue Code) are anticipated, unless specifically stated to the contrary.

21. The data gathered in the course of this assignment (except data furnished by the Client) shall remain the property of the Appraiser. The appraiser will not violate the confidential nature of the appraiser-client relationship by improperly disclosing any confidential information furnished to the appraiser. Notwithstanding the foregoing, the Appraiser is authorized by the client to disclose all or any portion of the appraisal and related appraisal data to appropriate representatives of the Appraisal Institute if such disclosure is required to enable the appraiser to comply with the Bylaws and Regulations of such Institute now or hereafter in effect.

22. You and Valbridge Property Advisors | Northern California both agree that any dispute over matters in excess of $5,000 will be submitted for resolution by arbitration. This includes fee disputes and any claim of malpractice. The arbitrator shall be mutually selected. If Valbridge Property Advisors | Northern California and the client cannot agree on the arbitrator, the presiding head of the Local County Mediation & Arbitration panel shall select the arbitrator. Such arbitration shall be binding and final. In agreeing to arbitration, we both acknowledge that, by agreeing to binding arbitration, each of us is giving up the right to have the dispute decided in a court of law before a judge or jury. In the event that the client, or any other party, makes a claim against Valbridge Property Advisors | Northern California or any of its employees in connections with or in any way relating to this assignment, the maximum damages recoverable by such claimant shall be the amount actually received by Valbridge Property Advisors | Northern California for this assignment, and under no circumstances shall any claim for consequential damages be made.

23. Valbridge Property Advisors | Northern California shall have no obligation, liability, or accountability to any third party. Any party who is not the "client" or intended user identified on the face of the appraisal or in the engagement letter is not entitled to rely upon the contents of the appraisal without the express written consent of Valbridge Property Advisors | Northern California. "Client" shall not include partners, affiliates, or relatives of the party named in the engagement letter. Client shall hold Valbridge Property Advisors | Northern California and its employees harmless in the event of any lawsuit brought by any third party, lender, partner, or part-owner in any form of ownership or any other party as a result of this assignment. The client also agrees that in case of lawsuit arising from or in any way involving these appraisal services, client will hold Valbridge Property Advisors | Northern California harmless from and against any liability, loss, cost, or expense incurred or suffered by Valbridge Property Advisors | Northern California in such action, regardless of its outcome.

24. The Valbridge Property Advisors office responsible for the preparation of this report is independently owned and operated by Valbridge Property Advisors | Hulberg & Associates, Inc. Neither Valbridge Property Advisors, Inc., nor any of its affiliates has been engaged to provide this report. Valbridge Property Advisors, Inc. does not provide valuation services, and has taken no part in the preparation of this report.

25. If any claim is filed against any of Valbridge Property Advisors, Inc., a Florida Corporation, its affiliates, officers or employees, or the firm providing this report, in connection with, or in any way arising out of, or relating to, this report, or the engagement of the firm providing this report, then (1) under no circumstances shall such claimant be entitled to consequential, special or other damages, except only for direct compensatory damages, and (2) the maximum amount of such compensatory damages recoverable by such claimant shall be the amount actually received by the firm engaged to provide this report.

26. This report and any associated work files may be subject to evaluation by Valbridge Property Advisors, Inc., or its affiliates, for quality control purposes.

27. Acceptance and/or use of this appraisal report constitutes acceptance of the foregoing general assumptions and limiting conditions.

Certification – Maria Aji, PhD

I certify that, to the best of my knowledge and belief:

1. The statements of fact contained in this report are true and correct.
2. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions and are my personal, impartial, and unbiased professional analyses, opinions, and conclusions.
3. I have no present or prospective interest in the property that is the subject of this report and no personal interest with respect to the parties involved.
4. The undersigned performed services, as an appraiser or in any other capacity, regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment.
5. I have no bias with respect to the property that is the subject of this report or to the parties involved with this assignment.
6. My engagement in this assignment was not contingent upon developing or reporting predetermined results.
7. My compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal.
8. My analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Professional Appraisal Practice.
9. Maria Aji, PhD has personally inspected the subject property.
10. No one provided significant real property appraisal assistance to the person signing this certification, unless otherwise noted.
11. The reported analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute.
12. The use of this report is subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives.
13. As of the date of this report, the undersigned has completed the Standards and Ethics Education Requirement for Candidates/Practicing Affiliates of the Appraisal Institute.

Maria Aji, Ph.D.
Senior Appraiser
California Certified License #AG027130

Certification – Norman C. Hulberg, MAI

I certify that, to the best of my knowledge and belief:

1. The statements of fact contained in this report are true and correct.
2. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions and are my personal, impartial, and unbiased professional analyses, opinions, and conclusions.
3. I have no present or prospective interest in the property that is the subject of this report and no personal interest with respect to the parties involved.
4. The undersigned performed services, as an appraiser or in any other capacity, regarding the property that is the subject of this report within the three-year period immediately preceding acceptance of this assignment.
5. I have no bias with respect to the property that is the subject of this report or to the parties involved with this assignment.
6. My engagement in this assignment was not contingent upon developing or reporting predetermined results.
7. My compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal.
8. My analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Professional Appraisal Practice.
9. Norman C. Hulberg, MAI did not personally inspect the subject property.
10. No one provided significant real property appraisal assistance to the person signing this certification, unless otherwise noted.
11. The reported analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute.
12. The use of this report is subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives.
13. As of the date of this report, the undersigned has completed the continuing education program for Designated Members of the Appraisal Institute.

Norman C. Hulberg, MAI
Senior Managing Director
California Certified License #AG003542

Addenda

Glossary

Definitions are taken from The Dictionary of Real Estate Appraisal, 6th Edition (Dictionary), the Uniform Standards of Professional Appraisal Practice (USPAP), and Building Owners and Managers Association International (BOMA).

Absolute Net Lease

A lease in which the tenant pays all expenses including structural maintenance, building reserves, and management; often a long-term lease to a credit tenant. (Dictionary)

Amortization

The process of retiring a debt or recovering a capital investment, typically through scheduled, systematic repayment of the principal; a program of periodic contributions to a sinking fund or debt retirement fund. (Dictionary)

As Is Market Value

The estimate of the market value of real property in its current physical condition, use, and zoning as of the appraisal date. (Dictionary)

Base Rent

The minimum rent stipulated in a lease. (Dictionary)

Base Year

The year on which escalation clauses in a lease are based. (Dictionary)

Building Common Area

In office buildings, the areas of the building that provide services to building tenants but which are not included in the office area or store area of any specific tenant. These areas may include, but shall not be limited to, main and auxiliary lobbies, atrium spaces at the level of the finished floor, concierge areas or security desks, conference rooms, lounges or vending areas, food service facilities, health or fitness centers, daycare facilities, locker or shower facilities, mail rooms, fire control rooms, fully enclosed courtyards outside the exterior walls, and building core and service areas such as fully enclosed mechanical or equipment rooms. Specifically excluded from building common area are floor common areas, parking space, portions of loading docks outside the building line, and major vertical penetrations. (BOMA)

Building Rentable Area

The sum of all floor rentable areas. Floor rentable area is the result of subtracting from the gross measured area of a floor the major vertical penetrations on that same floor. It is generally fixed for the life of the building and is rarely affected by changes in corridor size or configuration. (BOMA)

Certificate of Occupancy (COO)

A formal written acknowledgment by an appropriate unit of local government that a new construction or renovation project is at the stage where it meets applicable health and safety codes and is ready for commercial or residential occupancy. (Dictionary)

Common Area Maintenance (CAM)

The expense of operating and maintaining common areas; may or may not include management charges and usually does not include capital expenditures on tenant improvements or other improvements to the property. (Dictionary)

The amount of money charged to tenants for their shares of maintaining a [shopping] center's common area. The charge that a tenant pays for shared services and facilities such as electricity, security, and maintenance of parking lots. Items charged to common area maintenance may include cleaning services, parking lot sweeping and maintenance, snow removal, security and upkeep. (ICSC – International Council of Shopping Centers, 4th Ed.)

Condominium

A multiunit structure, or a unit within such a structure, with a condominium form of ownership. (Dictionary)

Conservation Easement

An interest in real estate restricting future land use to preservation, conservation, wildlife habitat, or some combination of those uses. A conservation easement may permit farming, timber harvesting, or other uses of a rural nature as well as some types of conservation-oriented development to continue, subject to the easement. (Dictionary)

Contributory Value

A type of value that reflects the amount a property or component of a property contributes to the value of another asset or to the property as a whole.

The change in the value of a property as a whole, whether positive or negative, resulting from the addition or deletion of a property component. Also called deprival value in some countries. (Dictionary)

Debt Coverage Ratio (DCR)

The ratio of net operating income to annual debt service (DCR = NOI/Im), which measures the relative ability of a property to meet its debt service out of net operating income; also called *debt service coverage ratio (DSCR)*. A larger *DCR* typically indicates a greater ability for a property to withstand a reduction of income, providing an improved safety margin for a lender. (Dictionary)

Deed Restriction

A provision written into a deed that limits the use of land. Deed restrictions usually remain in effect when title passes to subsequent owners. (Dictionary)

Depreciation

In appraisal, a loss in property value from any cause; the difference between the cost of an improvement on the effective date of the appraisal and the market value of the improvement on the same date.
In accounting, an allocation of the original cost of an asset, amortizing the cost over the asset's life; calculated using a variety of standard techniques. (Dictionary)

Disposition Value

The most probable price that a specified interest in property should bring under the following conditions:

- Consummation of a sale within a specified time, which is shorter than the typical exposure time for such a property in that market.
- The property is subjected to market conditions prevailing as of the date of valuation;
- Both the buyer and seller are acting prudently and knowledgeably;
- The seller is under compulsion to sell;
- The buyer is typically motivated;
- Both parties are acting in what they consider to be their best interests;
- An adequate marketing effort will be made during the exposure time;
- Payment will be made in cash in U.S. dollars (or the local currency) or in terms of financial arrangements comparable thereto; and

The price represents the normal consideration for the property sold, unaffected by special or creative financing or sales concessions granted by anyone associated with the sale. (Dictionary)

Easement

The right to use another's land for a stated purpose. (Dictionary)

EIFS

Exterior Insulation Finishing System. This is a type of exterior wall cladding system. Sometimes referred to as dry-vit.

Effective Date

The date on which the appraisal or review opinion applies. (SVP)

In a lease document, the date upon which the lease goes into effect. (Dictionary)

Effective Gross Income (EGI)

The anticipated income from all operations of the real estate after an allowance is made for vacancy and collection losses and an addition is made for any other income. (Dictionary)

Effective Rent
Total base rent, or minimum rent stipulated in a lease, over the specified lease term minus rent concessions; the rent that is effectively paid by a tenant net of financial concessions provided by a landlord. (TIs). (Dictionary)

EPDM
Ethylene Propylene Diene Monomer Rubber. A type of synthetic rubber typically used for roof coverings. (Dictionary)

Escalation Clause
A clause in an agreement that provides for the adjustment of a price or rent based on some event or index. e.g., a provision to increase rent if operating expenses increase; also called *escalator clause, expense recovery clause or stop clause*. (Dictionary)

Estoppel Certificate
A signed statement by a party (such as a tenant or a mortgagee) certifying, for another's benefit, that certain facts are correct, such as that a lease exists, that there are no defaults, and that rent is paid to a certain date. (Black's) In real estate, a buyer of rental property typically requests estoppel certificates from existing tenants. Sometimes referred to as an *estoppel letter*. (Dictionary)

Excess Land
Land that is not needed to serve or support the existing use. The highest and best use of the excess land may or may not be the same as the highest and best use of the improved parcel. Excess land has the potential to be sold separately and is valued separately. (Dictionary)

Excess Rent
The amount by which contract rent exceeds market rent at the time of the appraisal; created by a lease favorable to the landlord (lessor) and may reflect unusual management, unknowledgeable or unusually motivated parties, a lease execution in an earlier, stronger rental market, or an agreement of the parties. (Dictionary)

Expense Stop
A clause in a lease that limits the landlord's expense obligation, which results in the lessee paying operating expenses above a stated level or amount. (Dictionary)

Exposure Time
The time a property remains on the market.
The estimated length of time that the property interest being appraised would have been offered on the market prior to the hypothetical consummation of a sale at market value on the effective date of the appraisal;
Comment: Exposure time is a retrospective opinion based on an analysis of past events assuming a competitive and open market. (Dictionary)

Extraordinary Assumption
An assignment-specific assumption as of the effective date regarding uncertain information used in an analysis which, if found to be false, could alter the appraiser's opinions or conclusions.

Comment: Uncertain information might include physical, legal, or economic characteristics of the subject property; or conditions external to the property, such as market conditions or trends; or the integrity of data used in an analysis. (USPAP)

Fee Simple Estate
Absolute ownership unencumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat. (Dictionary)

Floor Common Area
In an office building, the areas on a floor such as washrooms, janitorial closets, electrical rooms, telephone rooms, mechanical rooms, elevator lobbies, and public corridors which are available primarily for the use of tenants on that floor. (BOMA)

Full Service (Gross) Lease
A lease in which the landlord receives stipulated rent and is obligated to pay all of the property's

operating and fixed expenses; also called a *full service lease*. (Dictionary)

Furniture, Fixtures, and Equipment (FF&E)

Business trade fixtures and personal property, exclusive of inventory. (Dictionary)

Going-Concern Value

An outdated label for the market value of all the tangible and intangible assets of an established and operating business with an indefinite life, as if sold in aggregate; more accurately termed the *market value of the going concern* or *market value of the total assets of the business.* (Dictionary)

Gross Building Area (GBA)

Total floor area of a building, excluding unenclosed areas, measured from the exterior of the walls of the above-grade area. This includes mezzanines and basements if and when typically included in the market area of the type of property involved.

Gross leasable area plus all common areas.

For residential space, the total area of all floor levels measured from the exterior of the walls and including the superstructure and substructure basement; typically does not include garage space. (Dictionary)

Gross Measured Area

The total area of a building enclosed by the dominant portion (the portion of the inside finished surface of the permanent outer building wall which is 50 percent or more of the vertical floor-to-ceiling dimension, at the given point being measured as one moves horizontally along the wall), excluding parking areas and loading docks (or portions of same) outside the building line. It is generally not used for leasing purposes and is calculated on a floor by floor basis. (BOMA)

Gross Up Method

A method of calculating variable operating expenses in income-producing properties when less than 100% occupancy is assumed. Expenses reimbursed based on the amount of occupied space, rather than on the total building area, are described as "grossed up." (Dictionary)

Gross Retail Sellout

The sum of the separate and distinct market value opinions for each of the units in a condominium, subdivision development, or portfolio of properties, as of the date of valuation. The aggregate of retail values does not represent the value of all the units as though sold together in a single transaction; it is simply the total of the individual market value conclusions. Also called the *aggregate of the retail values, aggregate retail selling price or sum of the retail values.* (Dictionary)

Ground Lease

A lease that grants the right to use and occupy land. Improvements made by the ground lessee typically revert to the ground lessor at the end of the lease term. (Dictionary)

Ground Rent

The rent paid for the right to use and occupy land according to the terms of a ground lease; the portion of the total rent allocated to the underlying land. (Dictionary)

HVAC

Heating, ventilation, air conditioning (HVAC) system. A unit that regulates the temperature and distribution of heat and fresh air throughout a building. (Dictionary)

Highest and Best Use

The reasonably probable use of property that results in the highest value. The four criteria that the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum productivity.

The use of an asset that maximizes its potential and that is possible, legally permissible, and financially feasible. The highest and best use may be for continuation of an asset's existing use of for some alternative use. This is determined by the use that a market participant would have in mind for the asset when formulating the price that it would be willing to bid. (IVS)

[The] highest and most profitable use for which the property is adaptable and needed or likely to be needed in the reasonably near future.

(Uniform Appraisal Standards for Federal Land Acquisitions) (Dictionary)

Hypothetical Condition

A condition, directly related to a specific assignment, which is contrary to what is known by the appraiser to exist on the effective date of the assignment results, but is used for the purpose of analysis.

Comment: Hypothetical conditions are contrary to known facts about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis. (USPAP)

Industrial Gross Lease

A type of modified gross lease of an industrial property in which the landlord and tenant share expenses. The landlord receives stipulated rent and is obligated to pay certain operating expenses, often structural maintenance, insurance and real property taxes, as specified in the lease. There are significant regional and local differences in the use of this term. (Dictionary)

Insurable Value

A type of value for insurance purposes. (Typically this includes replacement cost less basement excavation, foundation, underground piping and architect's fees). (Dictionary)

Investment Value

The value of a property to a particular investor or class of investors based on the investor's specific requirements. Investment value may be different from market value because it depends on a set of investment criteria that are not necessarily typical of the market. (Dictionary)

Just Compensation

In condemnation, the amount of loss for which a property owner is compensated when his or her property is taken. Just compensation should put the owner in as good a position pecuniarily as he or she would have been if the property had not been taken. (Dictionary)

Leased Fee Interest

The ownership interest held by the lessor, which includes the right to receive the contract rent specified in the lease plus the reversionary right when the lease expires. (Dictionary)

Leasehold Interest

The right held by the lessee to use and occupy real estate for a stated term and under the conditions specified in the lease. (Dictionary)

Lessee (Tenant)

One who has the right to occupancy and use of the property of another for a period of time according to a lease agreement. (Dictionary)

Lessor (Landlord)

One who conveys the rights of occupancy and use to others under a lease agreement. (Dictionary)

Liquidation Value

The most probable price that a specified interest in property should bring under the following conditions:

- Consummation of a sale within a short time period.
- The property is subjected to market conditions prevailing as of the date of valuation.
- Both the buyer and seller are acting prudently and knowledgeably.
- The seller is under extreme compulsion to sell.
- The buyer is typically motivated.
- Both parties are acting in what they consider to be their best interests.
- A normal marketing effort is not possible due to the brief exposure time.
- Payment will be made in cash in U.S. dollars (or the local currency) or in terms of financial arrangements comparable thereto.

The price represents the normal consideration for the property sold, unaffected by special or creative financing or sales concessions granted by anyone associated with the sale. (Dictionary)

Loan to Value Ratio (LTV)

The ratio between a mortgage loan and the value of the property pledged as security, usually expressed as a percentage. (Dictionary)

Major Vertical Penetrations

Stairs, elevator shafts, flues, pipe shafts, vertical ducts, and the like, and their enclosing walls. Atria, lightwells and similar penetrations above the finished floor are included in this definition. Not included, however, are vertical penetrations built for the private use of a tenant occupying office areas on more than one floor. Structural columns, openings for vertical electric cable or telephone distribution, and openings for plumbing lines are not considered to be major vertical penetrations. (BOMA)

Market Rent

The most probable rent that a property should bring in a competitive and open market reflecting the conditions and restrictions of a specified lease agreement, including the rental adjustment and revaluation, permitted uses, use restrictions, expense obligations; term, concessions, renewal and purchase options and tenant improvements (TIs). (Dictionary)

Market Value

The most probable price that a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:

- Buyer and seller are typically motivated;
- Both parties are well informed or well advised, and acting in what they consider their own best interests;
- A reasonable time is allowed for exposure in the open market;
- Payment is made in terms of cash in United States dollars or in terms of financial arrangements comparable thereto; and

The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale. (Dictionary)

Marketing Time

An opinion of the amount of time it might take to sell a real or personal property interest at the concluded market value level during the period immediately after the effective date of an appraisal. Marketing time differs from exposure time, which is always presumed to precede the effective date of an appraisal. (Advisory Opinion 7 of the Appraisal Standards Board of the Appraisal Foundation)

Master Lease

A lease in which the fee owner leases a part or the entire property to a single entity (the master lease) in return for a stipulated rent. The master lessee then leases the property to multiple tenants. (Dictionary)

Modified Gross Lease

A lease in which the landlord receives stipulated rent and is obligated to pay some, but not all, of the property's operating and fixed expenses. Since assignment of expenses varies among modified gross leases, expense responsibility must always be specified. In some markets, a modified gross lease may be called a *double net lease, net net lease, partial net lease, or semi-gross le*ase. (Dictionary)

Operating Expense Ratio

The ratio of total operating expenses to effective gross income (TOE/EGI); the complement of the net income ratio, i.e., OER = 1 – NIR (Dictionary)

Option

A legal contract, typically purchased for a stated consideration, that permits but does not require the holder of the option (known as the *optionee*) to buy, sell, or lease real estate for a stipulated period of time in accordance with specified terms; a unilateral right to exercise a privilege. (Dictionary)

Partial Interest
Divided or undivided rights in real estate that represent less than the whole, i.e., a fractional interest such as a tenancy in common, easement, or life interest. (Dictionary)

Pass Through
A tenant's portion of operating expenses that may be composed of common area maintenance (CAM), real property taxes, property insurance, and any other expenses determined in the lease agreement to be paid by the tenant. (Dictionary)

Potential Gross Income (PGI)
The total income attributable to property at full occupancy before vacancy and operating expenses are deducted. (Dictionary)

Prospective Future Value Upon Completion
A prospective market value may be appropriate for the valuation of a property interest related to a credit decision for a proposed development or renovation project. According to USPAP, an appraisal with a prospective market value reflects an effective date that is subsequent to the date of the appraisal report. … The prospective market value –as completed- reflects the property's market value as of the time that development is expected to be complete. (Dictionary)

Prospective Future Value Upon Stabilization
A prospective market value may be appropriate for the valuation of a property interest related to a credit decision for a proposed development or renovation project. According to USPAP, an appraisal with a prospective market value reflects an effective date that is subsequent to the date of the appraisal report …The prospective market value – as stabilized – reflects the property's market value as of the time the property is projected to achieve stabilized occupancy. For an income-producing property, stabilized occupancy is the occupancy level that a property is expected to achieve after the property is exposed to the market for lease over a reasonable period of time and at comparable terms and conditions to other similar properties. (Dictionary)

Replacement Cost
The estimated cost to construct, at current prices as of a specific date, a substitute for a building or other improvements, using modern materials and current standards, design, and layout. (Dictionary)

Reproduction Cost
The estimated cost to construct, at current prices as of the effective date of the appraisal, an exact duplicate or replica of the building being appraised, using the same materials, construction standards, design, layout, and quality of workmanship and embodying all of the deficiencies, superadequacies, and obsolescence of the subject building. (Dictionary)

Retrospective Value Opinion
A value opinion effective as of a specified historical date. The term *retrospective* does not define a type of value. Instead, it identifies a value opinion as being effective at some specific prior date. Value as of a historical date is frequently sought in connection with property tax appeals, damage models, lease renegotiation, deficiency judgments, estate tax, and condemnation. Inclusion of the type of value with this term is appropriate, e.g., "retrospective market value opinion." (Dictionary)

Sandwich Leasehold Estate
The interest held by the sandwich leaseholder when the property is subleased to another party; a type of leasehold estate. (Dictionary)

Sublease
An agreement in which the lessee in a prior lease conveys the right of use and occupancy of a property to another, the sublessee, for a specific period of time, which may or may not be coterminous with the underlying lease term. (Dictionary)

Subordination
A contractual arrangement in which a party with a claim to certain assets agrees to make his or her claim junior, or subordinate, to the claims of another party. (Dictionary)

Surplus Land
Land that is not currently needed to support the existing use but cannot be separated from the property and sold off for another use. Surplus land does not have an independent highest and best use and may or may not contribute value to the improved parcel. (Dictionary)

TPO
Thermoplastic polyolefin, a resilient synthetic roof covering.

Triple Net (Net Net Net) Lease
An alternative term for a type of net lease. In some markets, a net net net lease is defined as a lease in which the tenant assumes all expenses (fixed and variable) of operating a property except that the landlord is responsible for structural maintenance, building reserves, and management; also called *NNN lease, net net net lease, or fully net lease*. (Dictionary)

(The market definition of a triple net lease varies; in some cases tenants pay for items such as roof repairs, parking lot repairs, and other similar items.)

Usable Area
The measured area of an office area, store area, or building common area on a floor. The total of all the usable areas for a floor shall equal floor usable area of that same floor. (BOMA)

Value-in-Use
The value of a property assuming a specific use, which may or may not be the property's highest and best use on the effective date of the appraisal. Value in use may or may not be equal to market value but is different conceptually. (Dictionary)

VTAB
Value of the Total Assets of a Business. The value of a going concern (i.e. the business enterprise). (Dictionary)

Qualifications

Qualifications of Maria Aji, PhD
Senior Appraiser
Valbridge Property Advisors | Northern California

Independent Valuations for a Variable World

State Certifications

Certified General
State of California

Education

Ph.D.
Urban and Regional Planning
University of Southern California,
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University of Cincinnati

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National University of Greece
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Certificate in International
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Experience

Senior Appraiser
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(2015-Present)

Appraiser
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(2013-2014)

Hulberg & Associates, Inc. (2001-2013)
(joined to create Valbridge in 2013)
San Jose, CA

Associate Appraiser
The Property Sciences Group, Inc. (1998-2001)
San Jose, CA

Researcher
Nanyang Technological University, Business School
(1994-1995)
Singapore

Market Research Director
Grubb & Ellis Company (1993-1994)
San Jose, CA

Economic/Planning Consultant
Gruen Gruen & Associates (1992-1993)
San Francisco, CA

Research Associate
Practical Research for Planning, Inc., Pasadena, CA
(1991-1992)
Pasadena, CA

Appraisal/valuation and consulting assignments include: professional/ medical offices, shopping centers, mixed-use projects, gas stations, oil-changing facilities, vacant land, single family homes, apartments, condominiums, vacant land, light industrial, manufacturing, and research and development buildings, condominiums, warehouses, industrial parks, mini-storage facilities, vacant land, and special purpose properties.

Qualifications of Norman C. Hulberg, MAI
Senior Managing Director
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State Certifications

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Member: Appraisal Institute – MAI Designation
Member: Association of Independent Office Parks
Member: Rotary Club of San Jose/Board of Directors
Member: San Jose Silicon Valley Chamber of Commerce
Member: Santa Clara County Bar Association

Appraisal Institute & Related Courses

Continuing education courses taken through the Appraisal Institute and other real estate organizations.

Experience

Senior Managing Director
Valbridge Property Advisors | Northern California (2013-Present)

President
Hulberg & Associates, Inc. (1976-2013) (joined to create Valbridge in 2013)

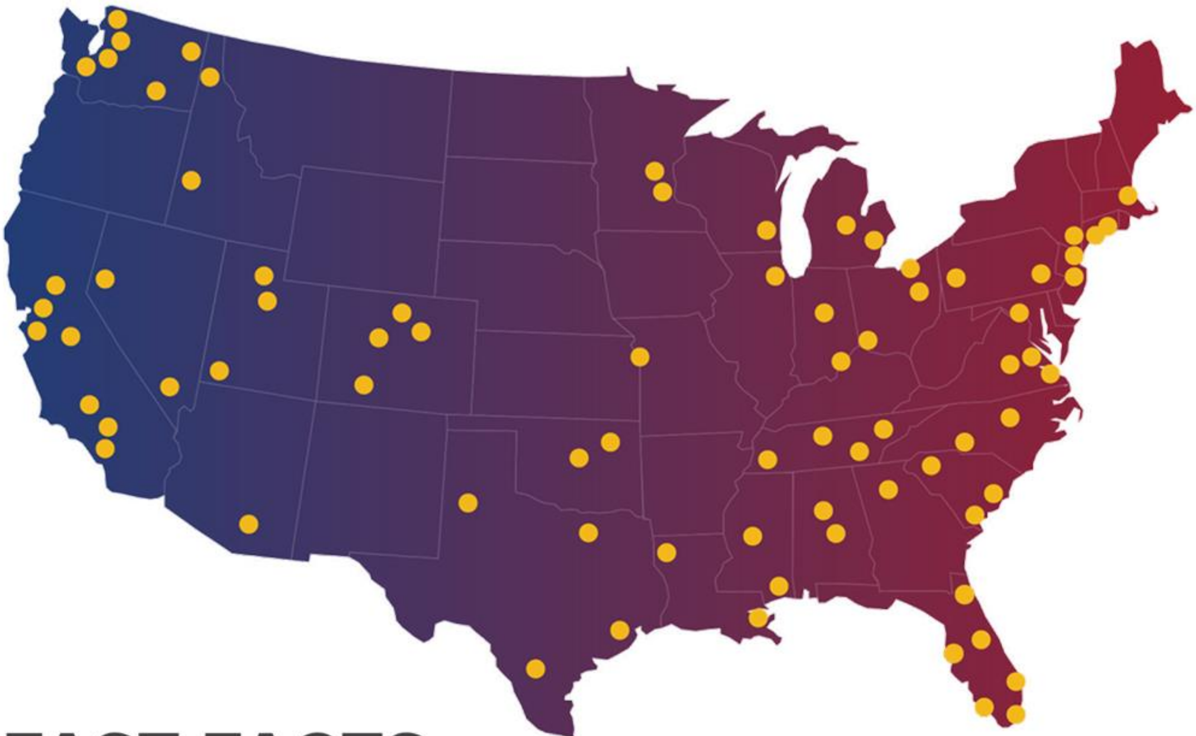
Appraisal/valuation and consulting assignments include: Single-family, condominium, apartments, land, mobile home parks. Office buildings, hotels/motels, service stations, retail, vacant land. Industrial plants, research and development, warehouses, vacant land. Fractional interest valuations, contaminated properties, special purpose properties, feasibility studies, market studies, condemnation, construction defects, litigation support, mediations, arbitrations and review appraisals.

Mr. Hulberg has provided valuation services in a wide variety of complex civil litigation including real estate, land use cases, condemnation, estate matters, property taxation, contract disputes, partnership and corporate disputes, environmental lawsuits, professional negligence cases, construction defect, and bankruptcy/creditors matters.

Qualified as an expert witness in most counties in the San Francisco and Monterey Bay and Central Valley areas, as well as and in the U.S. Tax Court in the U.S. District Courts in San Jose, San Francisco, Oakland, and Las Vegas. He is a highly experienced forensic appraiser, having provided testimony on over 300 occasions. This includes over 100 jury trials in state and federal courts in addition to numerous court trials. He has also testified in major arbitrations and before state and federal courts, as well as private arbitrations.

ATTACHMENT 1

Valbridge
PROPERTY ADVISORS



FAST FACTS

COMPANY INFORMATION

- Valbridge is the largest independent national commercial real estate valuation and advisory services firm in North America.
  - Total number of MAI-designated appraisers: 200+ on staff
  - Total number of office locations: 70+ across U.S.
  - Total number of staff: 675+ strong
- Valbridge covers the entire U.S. from coast to coast.
- Valbridge services all property types, including special-purpose properties.
- Valbridge provides independent valuation services. We are not owned by a brokerage firm or investment company.
- Every Valbridge office is led by a senior managing director who holds the MAI designation of the Appraisal Institute.
- Valbridge is owned by our local office leaders.
- Valbridge welcomes single-property assignments as well as portfolio, multi-market and other bulk-property engagements.

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ATTACHMENT 1

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RESOLUTION NO. 2020-35

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS UPDATING PARK IN LIEU FEES

WHEREAS, Chapter 13.24 of the Los Altos Municipal Code requires as a condition of approval of a final subdivision or parcel map, the subdivider shall dedicate land or pay a fee in lieu thereof; and

WHEREAS, Los Altos Municipal Code, Section 13.24.010, subdivision (F), provides that each fiscal year the Director of Public Works (now the Engineering Services Director) shall make a determination of the fair market value of the lands available for park purchase to be used in calculating a Park In-Lieu Fee to be paid; and

WHEREAS, the Engineering Services Director has made a determination of the fair market value of lands available for park purchase is $10.78 million per acre, resulting in Park In-Lieu Fees of $87,300 for Single Family Residential Units and $55,000 for Multiple Family Residential Units; and

WHEREAS, the City Council desires to increase the Park In-Lieu Fees to ensure that the fees will continue to generate sufficient funds to acquire land and construct the park and recreational facilities needed to serve new development.

NOW THEREFORE, BE IT RESOLVED, that the City Council of the City of Los Altos hereby approves the Park In-Lieu Fees in the amounts of $87,300 per Single Family/Detached Residential Unit and $55,000 per Multiple Family/Attached Residential Unit and these fees shall become effective immediately. The City Clerk is hereby directed to update the FY 2018/19 City of Los Altos Fee Schedule that was originally approved by Resolution 2018-14, to reflect the Park In-Lieu Fees as modified herein.

I HEREBY CERTIFY that the foregoing is a true and correct copy of a Resolution passed and adopted by the City Council of the City of Los Altos at a meeting thereof on the 13th day of October, 2020 by the following vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

____
Janis C. Pepper, MAYOR

Attest:

____
Andrea M. Chelemengos, MMC, CITY CLERK

LEAGUE OF WOMEN VOTERS®
OF LOS ALTOS-MOUNTAIN VIEW AREA

October 11, 2020

Mayor Pepper and Members of the City Council
City Hall
1 North San Antonio Road
Los Altos, CA 94022

Re: Council Meeting Oct.13, Item #10 – Park In-Lieu Fees

The League of Women Voters would like to suggest that Council consider waiving or reducing park in-lieu fees for below-market-rate units (BMRs) that a developer provides above and beyond what is required to receive the State Density Bonus and to comply with our local inclusionary ordinance. We also suggest waiving them entirely for all-affordable housing developments, should any be proposed.

We agree that parkland is vital to our residents, but the size of these fees can serve as an impediment to building much needed affordable housing. Other jurisdictions have adopted similar policies. The Council has encouraged the developer of 5150 El Camino Real, for example, to provide more BMRs. Lower park-in-lieu fees might be a way to incent these additional BMRs.

As an aside, the Staff Report references affordable housing impact fees; we don't believe these fees were ever adopted by the Council.

Sue Russell
Co-Chair, Housing Committee, LWV of the Los Altos-Mountain View Area
Cc: Chris Jordan Jim Sandoval Sharif Etman

October 12th, 2020

Mayor Pepper and Members of the Los Altos City Council

1 North San Antonio Road, Los Altos, CA 94022

Re: Council Meeting, October 13th Item #10 – Park In-Lieu Fees

I am writing to you in regards of the proposed increase on multi family park in lieu fees. I think that everybody understands that fees must be updated based on appraisals and market rate and yearly evaluation should continue. At your last meeting Jan 2019, when Council implemented the last increase you have also discussed that BMR's park In-lieu fees could be waived since that would be helping generating more BMR's. BMR's generation translate on a net loss to any development. Since your January 2019 Park In-Lieu Fees meeting I have been following up with emails with Jon Biggs on this topic to schedule it for an open discussion with council and every time I was told that council did not ask for the topic to be brought back, or there were some other priorities. I understand that council is busy but, it is better to have a discussion before developments are in the approval process in front of City Council for review, that will help developers to proper plan on offering more BMR's. Currently city of Los Altos does not have any incentives to create additional BMR's above 15% BMR requirement. As an example, City of Santa Clara offers 50% reduction on all fees (park in-lieu, traffic etc) on all BMR's provided by the developer.

There are several issues with the appraisal provided by Valbridge Advisors:

1. Appraisal was done Feb 2020 (pre Covid data) and the commercial sales/land valuation changed substantially that mandates a new appraisal and evaluation of current data/sales as of last months and not pulling 2017-2018 irrelevant land sales data some initially used for Jan 2019 Park in Lieu-Fee CC meeting. Appraiser should use sales data from late 2019 and 2020 to date, same methodology used by Santa Clara County for property tax purposes assessments.
2. Incorrect data use: Page 51 references 4115 ECR Palo Alto property sold for $7.650M but this price is as entitled for 7 residential condominiums, 5000 SF retail and 2000 SF office the real value of the unentitled land was $4.550M when it closed Nov 2016. The other Palo Alto and Mountain View sales have to be verified too to ensure proper reporting and differentiate between unentitled and entitled land sales.

Regards,

[redacted] 10/12/2020

Mircea Voskerician

Property owner 4846/4856 ECR Los Altos, CA, 94022

LOS ALTOS
CHAMBER OF COMMERCE

October 13, 2020

Honorable Mayor Pepper, Vice Mayor Fligor, City Council Members and City Staff:
This letter is submitted for your consideration on behalf of the Los Altos Chamber of Commerce for the Council Meeting scheduled for October 13, Item #10 – Park In-Lieu Fees.

Affordable housing is a major challenge for our business community--especially for our employees, our teachers, and city staff. It is nearly impossible for employees to live here-- in the city that they support.

As we look at the increasing RHNA goal for the City of Los Altos, the City Council must look at a myriad of solutions to achieve this goal. Producing 100% affordable projects remains the most effective strategy to producing affordable housing. The Council is decreasing restrictions on ADUs as well, but we must also find other avenues to incentivize developers to increase the number of BMRs that are included in each multi-family project. With that in mind, the Los Altos Chamber of Commerce would like to ask the City to consider a few possible "on menu" incentives for Below Market Rate Units (BMRs) for sale or rental.

1. **Reducing the park in-lieu fees for BMRs**

Here is a possible tiered incentive chart:

BMR Percentage	**Park in Lieu Fee Waiver**	**Full Solar Power for BMR Units**
Required min. 15% BMR units	50% Park in Lieu Fee Waiver	70% Park in Lieu Fee Waiver
Above 15% to 16% BMR units	60% Park in Lieu Fee Waiver	80% Park in Lieu Fee Waiver
Above 16% to 17% BMR units	70% Park in Lieu Fee Waiver	90% Park in Lieu Fee Waiver
Above 17% to 18% BMR units	80% Park in Lieu Fee Waiver	100% Park in Lieu Fee Waiver
Above 18% to 19% BMR units	90% Park in Lieu Fee Waiver	110% Park in Lieu Fee Waiver
Above 19% BMR units	100% Park in Lieu Fee Waiver	120% Park in Lieu Fee Waiver

2. A bonus for providing solar power for common spaces and to all BMR units.

An additional "on menu" option could be realized when solar power is provided to the BMRs units. The applicant would move up two tiers to a higher % of fee waiver. Additional credit above 100% (+10% or +20%) would be applied to other scheduled fees.

A Park in Lieu Fee waiver would put us in alignment with other jurisdictions, such as the City of Santa Clara which has adopted a 50% fee waiver policy for all BMR units. Our proposed policy would be the same at the required baseline of 15% BMRs with a tiered increase as BMR percentages increase.

Parkland is vital to our residents, but Park in Lieu fees can serve as an impediment to building much needed affordable housing. Let's flip that around and incentivize developers for including maximum numbers of BMR units and providing solar power to those units. Thank you for your consideration of this proposal.

[redacted]

Kim Mosley
President
Los Altos Chamber of Commerce
321 University Avenue
Los Altos, CA 94022

DISCUSSION ITEM

Agenda Item # 9

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Memorandum of Understanding with the County of Santa Clara for of an Affordable Housing Project at 330 Distel Circle

Prepared by: Jon Biggs, Community Development Director
Approved by: Chris Jordan, City Manager

Attachment(s):
1. Draft Memorandum of Understanding with the County of Santa Clara

Initiated by:
Staff

Previous Council Consideration:
None

Fiscal Impact:
If entered in the amounts indicated in the agreement, the City will provide this project a 100% discount in the City's Park In-Lieu Fee and the City's Traffic Impact fees. These impact fee reductions equate to the following estimates:

- $4,392,000 in Park In-Lieu Fees
- $252,344 in Traffic Impact Fees
- <u>$4,644,344 Total</u>

Environmental Review:
The City Council hereby finds and determines that the tproposed Memorandum of Understanding with the County of Santa Clara has been assessed in accordance with the California Environmental Quality Act (Cal. Pub. Res. Code, § 21000 et seq.) ("CEQA") and the State CEQA Guidelines (14 Cal. Code Regs. § 15000 et seq.) and is categorically exempt from CEQA under CEQA Guidelines, § 15061(b)(3), which exempts from CEQA any project where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. The City Council further finds that the authorization to enter into the Memorandum of Understanding with County of Santa Clara would not be an activity with potential to cause significant adverse effect on the environment because its related to the organizational or administrative activities of the City and will not result in direct or indirect physical changes in the environment, and therefore is exempt from CEQA.

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	JH	SE

Subject: Memorandum of Understanding with the County of Santa Clara for of an Affordable Housing Project at 330 Distel Circle

Policy Question(s) for Council Consideration:
Does the City Council want to Authorize the City Manager to enter into a Memorandum of Understanding (MOU) with County of San Clara to facilitate the Development of an affordable housing project at 330 Distel Circle?

Summary:
- Does the City Council want to enter into an agreement with the County of Santa Clara for an affordable Housing Project at 330 Distel Circle?
- Does the City Council want to give a 100% discount to the City's Park In-Lieu Fee and the City's Traffic Impact fee?

Staff Recommendation:
Staff has discussed the MOU with the Council subcommittee of Mayor Pepper and Vice Mayor Fligor and the subcommittee and staff recommend approval of the MOU.

Purpose
Partner with the County of Santa Clara to provide affordable housing (BMR) units in the City of Los Altos.

Background

The County has entered into a Purchase and Sale Agreement (the "Purchase Agreement") with Midpeninsula Regional Open Space District to acquire property known as 330 Distel Circle in the City of Los Altos (the "Property") for the purpose of developing affordable and supportive multifamily housing, and utilizing funds from the County's 2016 Measure A Affordable Housing Bond ("Housing Bond"). The Purchase Agreement is contingent on the County's due diligence review of the Property and the potential development, including a commitment from the City on entitlements for the Project.

The purpose of this MOU is to set forth the parties' support for a potential affordable housing development at Property and outline a path for potential waiver of contingencies by the County under the Purchase Agreement. The County is considering acquiring the Property to develop, or ground leasing the property to a developer to develop the affordable housing project.

The site is located in the CT "Commercial Thoroughfare" zone district and multiple-family housing projects are a conditional use in this zone district. Design review approval and CEQA review will be components of the project as well. The Project is anticipated to contain a minimum of 90 units, with 100% of the units restricted to occupants earning 120% or less of the area medium income (AMI) with a minimum of 75% earning 80% or less of the AMI. Households earning 80% or less of the area medium income are "low-income" households and those earing up 120 % of the AMI are moderate income households.

The County would solicit an affordable housing developer, either by issuing an RFP or selecting from a pre-approved list, and would impose development requirements and affordable housing restrictions on the Project through a ground lease with the developer and/or conditions set forth in Measure A loans provided to the developer.

In furtherance of it's support of this Project, staff is proposing to provide the Project with a discount of 100% from the City's impact fees. The total, non-discounted impact fees for the Project are currently estimated to be [$4,392,000 for park in lieu fees and $252,344.08 for traffic impact fees – total of $4,644,344].

Discussion/Analysis

In partnering with the City, the County of Santa Clara is providing an opportunity to expand affordable housing in Los Altos, especially at the low-income level. The reduction in the park in-lieu and traffic impact fees can be considered a financial contribution to supporting the development of this project.

Options

1) Option #1 – Authorize the City Manager to enter into an agreement with the County of Santa Clara

Advantages: Results in the opportunity to increase the supply of affordable housing units in Los Altos

Disadvantages: Impacts the growth of the park in-lieu and traffic impact funds

1) Option #2 – Decline to Authorize the City Manager to enter into an agreement with the County of Santa Clara

Advantages: Helps preserve the growth of the park in-lieu and traffic impact funds.

Disadvantages: Results in a missed opportunity to obtain affordable housing units in Los Altos

Recommendation

The staff recommends Option 1.

DRAFT

MEMORANDUM OF UNDERSTANDING
330 DISTEL CIRCLE

This Memorandum of Understanding (this "MOU") is made as of _________, 2020, by and between the CITY OF LOS ALTOS, a municipal corporation of the State of California (the "City"), and the COUNTY OF SANTA CLARA, a political subdivision of the State of California (the "County").

WHEREAS, the County expects to enter into a Purchase and Sale Agreement (the "Purchase Agreement") with MidPeninsula Regional Open Space District to acquire property known as 330 Distel Circle in the City of Los Altos (the "Property") for the purpose of developing affordable and supportive multifamily housing, utilizing funds from the County's 2016 Measure A Affordable Housing Bond ("Housing Bond").

WHEREAS, the Housing Bond is a $950 million affordable housing bond measure passed by voters in Santa Clara County in 2016. The Housing Bond is part of an ongoing effort to: 1) increase affordable housing opportunities for our community's most vulnerable and poorest residents; and, 2) to prevent and reduce homelessness throughout Santa Clara County. The Housing Bond builds on key policy shifts and communitywide partnerships that have occurred over the last five years.

WHEREAS, the Purchase Agreement is contingent on the County's due diligence review of the Property and the potential development, including a commitment from the City on entitlements for the Project (defined below).

WHEREAS, the purpose of this MOU is to set forth the parties' support for a potential affordable housing development at Property and outline a path for potential waiver of contingencies by the County under the Purchase Agreement.

NOW THEREFORE, the parties hereby declare and acknowledge the following:

1. The County is considering acquiring the Property to develop, or to ground lease to a developer to develop, an affordable housing project (the "Project").
2. The Project is anticipated to contain a minimum of 90 units, with 100% of the units restricted to occupants earning 120% or less of the area medium income (AMI), with a minimum of 75% earning 80% or less of AMI. The Parties acknowledge that the final affordability restrictions will depend in part on the requirements of available funding sources, including tax credit financing.
3. The County would solicit an affordable housing developer, either by issuing an RFP or selecting from a pre-approved list, and would impose development requirements and affordable housing restrictions on the Project through a ground lease with the developer and/or conditions set forth in Measure A loans provided to the developer.
4. The City supports the development of affordable housing on the Property and of the Project as described above and will provide transparency and flexibility, to the extent possible, in the entitlement process for the Project. The City shall be the agency responsible for the review and approval of zoning and land use requirements for the Project and shall receive any RHNA credits issued in connection with the Project. The City acknowledges that the County will need binding [entitlements] for the Project prior to [insert date which is 180 days after execution of PSA] in order for the County to waive contingencies under the Purchase Agreement.

5. In furtherance of it's support of the Project, the City intends to provide the Project with a discount of up to 100% from the City's impact fees. The total, non-discounted impact fees for the Project are currently estimated to be $252,344.08 for traffic fees and $4,392,000 for park in lieu fees.
6. The parties further declare and acknowledge that the City's and the County's commitment to the Project are subject to compliance with all legal requirements, including but not limited to, compliance with the California Environmental Quality Act. Nothing in this MOU shall be construed to compel the County or City to approve or make any particular findings with respect to any environmental documentation that is prepared, pursuant to CEQA, for any portion of the Project. The City retains its full discretion to refuse to approve any CEQA document prepared to analyze the environmental impacts of the Project.

CITY OF LOS ALTOS

____
Name:
Title:

APPROVED AS TO FORM:

____
Name:
Title:

COUNTY OF SANTA CLARA

____
Name:
Title:

APPROVED AS TO FORM AND LEGALITY:

____
Karen M. Willis, Deputy County Counsel

DISCUSSION ITEM

Agenda Item # 10

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: Amendment No. 4 to the Agreement between the City of Los Altos, California and Noll and Tam Architects for the additional Design / Professional Consulting Services for Hillview Community Center Redevelopment Project CF-01002.

Prepared by: Peter Maslo, Project Manager
Reviewed by: Jim Sandoval, Engineering Service Director
Approved by: Chris Jordan, City Manager

Attachment(s):
Attachment 1--Noll and Tam's Additional Service Requests 8 - 16
Attachment 2--Noll and Tam's Supporting Data tables during and after Shelter-in-Place Orders

Initiated by:
City Council – CIP Project CF - 01002

Previous Council Consideration:
October 13, 2020; July 30, 2019; July 9, 2019; March 12, 2019; September 11, 2018; July 10, 2018; March 13, 2018; December 12, 2017; September 26, 2017; August 22, 2017, May 23, 2017; April 25, 2017;

Fiscal Impact:
The following contract amendment will cost $425,863 and an additional 20% contingency would cost $85,173. Both costs will be funded by the $38.3M budget approved by the City Council for development of the Los Altos Community Center Project CF – 01002 in the Capital Improvement Program.

- Breakdown of funding source to be used:
  - $425,863 (contract amendment) - General Fund
  - $85,173 (20% contingency) – General Fund
- Amounts already included in approved budget? Yes
- Amount above budget requested: $0

The cost for each Additional Service Request (i.e., ASR 8 through ASR 16) in contract Amendment No. 4 are broken-out in the following table.

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	JH	SE

Subject: Professional Design Services Agreement Amendment: Community Center Project

Additional Service Requests

PROJECT ITEM	PROJECT BUDGET
ASR 8 – Revisions to Kinder Prep	$3,340
ASR 9 – Fire Department Revision to Standpipe System	$9,640
ASR 10 – Access Control and Security Revision	$9,562
ASR 11 – Schedule Extension	$194,480
ASR 12 – Extension to Geotechnical Services	$29,301
ASR 13 – Addition of Graphics to Signage	$6,620
ASR 14 – COVID19 Extension	$141,000
ASR 15 – Irrigation Controller Revisions	$14,640
ASR 16 – Exterior Lighting and Sculpture Foundation	$17,280
TOTAL PROJECT BUDGET	**$425,863**

Environmental Review:
Not applicable

Policy Question(s) for Council Consideration:
- None

Summary:
- Noll & Tam is contracted with the City as the Architect for the design and architectural services of Los Altos Community Center.
- Amendment No. 4 modifies the scope of services to add design updates that have arisen during construction and unforeseen delays to the construction schedule, including revisions to the Kinder Prep space, revisions to standpipe system by the Fire Department, revisions to the Access Control and Security System, schedule extensions for the architectural team to align with unforeseen delays in the construction schedule (i.e., non-COVID19 delays), additional Geotechnical Services required for ASR-1 approved by Council in 2018, changes to the facility's interior signage, schedule delays caused by COVID19, revision to the adjacent baseball and soccer fields' Irrigation Controller Systems, and the addition of exterior lighting that was missed in the original exterior lighting plan.

Staff Recommendation:
Authorize the City Manager to execute Contract Amendment No. 4 on behalf of the City with Noll & Tam Architects for additional construction services necessary for the Los Altos Community Center construction project in the amount of $425,863 and up to a 20% contingency amount of $85,173 on behalf of the City, should additional amendments become necessary to address future unforeseen circumstances that could arise during construction.

Subject: Professional Design Services Agreement Amendment: Community Center Project

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Purpose[1]

Execute an amendment for $425,863 to the existing agreement with Noll & Tam Architects for the Los Altos Community Center Project.

Background

On August 22, 2017, Council authorized the execution of a professional services agreement between the City of Los Altos and Noll & Tam Architects in an amount not to exceed $2,804,597 for design services for the Community Center Project.

Amendment No.1 was approved by the City Council on June 4, 2018 to revise the term of contract from FY2017/18 to FY2020/21.

Amendment No. 2 was approved by the City Council on August 7, 2018 in the amount of $467,781 for the following modifications to the scope of services (SOS): increase building quality, increase building functionality, upgrade from LEED silver equivalent to LEED Gold equivalent, improve pedestrian connectivity to the library, increase building area by 3,000 S.F., increase outdoor program space, and re-design the parking lot.

Amendment No. 3 was approved by the City Council on July 30, 2019 in the amount of $93,420 for the Children's Corner, Stormwater, Solar PV System, Fire Hydrant Line Easement, Arborist Construction Administration Phase Activities, and Exterior Envelope Waterproofing Review.

Discussion/Analysis

The subject Amendment No. 4 includes necessary design updates that have arisen during construction and unforeseen delays to the Community Center's construction schedule. A detailed breakdown of the request is shown below:

- **ASR 8 – Revisions to the Kinder Prep Area $3,340:** Provide design for interior decoration of wall surfaces, revise height of windowsill, eliminate carpeting, add open shelving at north-east corner of the space.
- **ASR 9 – Fire Department Revision to Standpipe System $9,640:** The Contract Documents provided a building mounted standpipe system connected to the building fire suppression system as reviewed by the Santa Clara County Fire Department (SCCFD). In a meeting with SCCFD on 12/18/19, they clarified that standpipes shall be independent of the building fire suppression system and required that the wharf hydrants be located in the

[1] NOTE: at the October 13, 2020 City Council meeting, the Council deferred consideration of Contract Amendment No. 4 until staff returns with a status update (i.e., budget and schedule) of the overall Community Center construction project. Staff will present this update when the Amendment No. 4 agenda item is heard by the Council at the October 27, 2020 City Council Meeting. For additional background, the Council is advised to review the latest monthly project status report, which is uploaded by staff each month for the public and Council to review at https://www.losaltosca.gov/publicworks/page/los-altos-community-center.

landscape and the previously agreed building mounted standpipes be removed from the project. ASR 9 provides for the design effort to revise the concept diagram, design coordination to locate wharf hydrants in the landscape and contract document revisions to meet the SCCFD's updated review comments.

- **ASR 10 – Access Control and Security Revision $9,562:** Attend meetings with the City, coordinate security and access revisions with architectural elements; coordinate door hardware revisions with hardware consultant, document and issue the changes in Architect Supplemental Instruction (ASI) 26 and ASI 27.
- **ASR 11 – Schedule Extension $194,480:** Additional Service Request to cover a schedule extension of 3 months. Noll and Tam's project fee proposal estimated a 12 to 14-month construction period. In comparison, the General Contractor's construction schedule at the time of award shows the project spanning from Notice to Proceed issued on 9/3/2019 to Substantial Completion date of 11/25/2020, a period of roughly 15 months. The City awarded the construction bid on 7/30/2019 and Noll and Tam began Construction Administration activities 8/1/2019 which, coupled with the contractor's 15-month construction schedule, lengthens the total Construction Administration phase to 16 months. This includes all required sub-consultant costs. Given the indeterminate Construction Administration period cited in Noll and Tam's original proposal, an additional fee proposal covering a 3 month extension is proposed to bring the Design Team's Construction Administration period into alignment with the Contractor's original Substantial Completion date of 11/25/2020.

- **ASR 12 – Extension to Geotechnical Services $29,301:** This ASR provides extended geotechnical services, quality control and testing for the underground utilities, pavement areas, trash enclosure, transformer pad, and the library connector. Noll and Tam's base contract covered geotechnical services for a building within the footprint of the now demolished Hillview Community Center and assumed no significant changes to the footprint of the existing parking lot. The approved Schematic Design expanded the project scope incorporating a revised parking lot and the library connector, which significantly expanded the scope of the project's site work. After the City Council's approval of the expanded site and larger building, Council approved ASR 1 on August 7, 2018, which provided an additional design fee to the design team for expanded project scope. When the City Council approved ASR 1, the need for additional geotechnical engineering was indeterminate and therefore geotechnical services were excluded from ASR 1. During the construction project however, it was determined that the Contract geotechnical fee would be insufficient to cover the expanded scope of site improvements approved by the Council in 2018.
- **ASR 13 – Addition of Graphics to Signage $6,620:** Enhancement of facility identity with the addition of graphics to interior signage and the adjustment of room names.
- **ASR 14 – COVID19 Extension $141,000:** ASR 14 represents the service proposal associated with delays caused by the COVID19 shelter-in-place (SiP) order. The construction schedule has been extended by approximately 3.5 months (from November 2020 through March 2021)

due to delays caused by the shutdown of construction caused by COVID19 and the inefficiencies the contractor has experienced as a result of following COVID19 health and safety protocols and the challenge of repopulating its labor pool after construction resumed. During the SiP shutdown, Noll & Tam and their subcontractors continued to provide construction support services with a level of effort close to normal construction operations. These services include reviewing and approving contractor's shop drawings to confirm the work meets the contract requirements, assisting the contractor with interpretation of the contract documents, attending weekly project meetings, pre-construction meetings with certain trades and special meetings, all which have been remote. After the County's health order allowed construction to resume during the SiP, Noll & Tam's work effort continued at a slightly diminished rate compared to the period when site activities were shut down. The cessation of field activities inserted a disconnection of submittals from field progress which created inefficiencies for both the contractor and the architect's administration of the field work. Lack of site access and remote meetings during the shutdown was significant because neither the design nor construction teams could access work in place to verify conditions, as required to produce shop drawings, and detailed review of work in place was not possible. Post shutdown, conformance to COVID19 protocols reduced the general contractor's productivity lengthening the duration of the project and extending the period of Noll and Tam's administrative duties.[2] (Please note that City staff is currently working with Gonsalves & Stronck (general contractor) on additional COVID19 related schedule impacts that may

[2] Before and during staff's presentation of the Amendment No. 4 agenda item to the City Council on October 13, 2020, the Council seemed to question why Noll & Tam (N&T) needed to keep working during the SiP construction shutdown. In consideration of the questions that were asked of staff, a little background information on what architectural teams do to support the construction of their designs is provided herein.

It is industry practice for the design team to be retained for construction support to serve as the owner's interpreter of the P&Ss and contract documents, particularly for building projects that have literally hundreds or thousands of details that require consultation between the designers and the building contractor. For example, the support tasks include:

- Requests for Information (RFI's)--a formal written process in which parties, such as the contractor and designer, clarify information gaps in construction documents. N&T received and/or responded to 31 RFI's (of a total of 188 received to date – 16% of total received) during the COVID shutdown. RFIs from the contractor will continue through project completion. Attachment #2 lists the RFIs received during the shutdown.
- Submittals: N&T received and/or responded to 89 submittals during the shutdown (i.e., 17% of the 518 submittal reviews on N&T's current log). Submittals are physical examples and specifications of the materials or products proposed for installation by the contractor. N&T reviews every submittal to assure the materials comply with the plans and specs.
- Architect's Supplemental Instructions (ASIs): ASIs are used by the architect to issue additional instructions or interpretations, or to order minor changes in the work and Architectural Sketches (ASKs)--architectural sketches developed for something as small as a clarification of door trim or as encompassing as providing verification of dimensional layout for all light fixtures. During the shutdown, 21 ASIs and 10 ASKs were issued by N&T in response to RFI/submittals and construction issues.
- Review of shop drawings from the contractor: shop drawings are contractually required for significant portions of the work and often require field verified dimensions. For example, if the rough framing for the building is not in place or complete at the time of a shop drawing submittal, fabrication dimensions can be estimated but they cannot be field verified. So quite often upon field verification of dimensions, shop drawings are re-submitted for a second (and sometimes third) review.

As noted above, N&T reported inefficiencies caused by COVID19. A prime example of an inefficiency they experienced, which can be attributed to the site shutdown, was field verification of dimensions on shop drawings. An example of this in the Community Center project is the building's fiber cement panels which are a feature element of the Community Room and Senior's façades. In the case of the cement fiber panels, N&T noted in their mockup review the incorrect coordination of the cement fiber panels with adjacent work. They believe the coordination error is due to lack of field verified dimensions based on limited site access during the COVID shutdown.

push the project completion date past March 2021. If this occurs, then staff will accordingly return to City Council to extend Noll and Tam Architects' contract.)

- **ASR 15 – Irrigation Controller Revisions $14,640:** Integration and upgrade of the baseball and soccer field irrigation system as part of LACC project. Revisions to the legend, plans and details, and coordination with the consultants and rain master representative. This scope of design work was identified as an important update during the construction administration phase.
- **ASR 16 – Exterior Lighting and Sculpture Foundation $17,280:** Provide electrical, lighting design for flagpole and exterior 110V receptacles, and design studies for placement and lighting for three sculptures. This scope of work gap was identified during construction and not included in the initial design scope of work.

The added fee request by Noll and Tam Architects for the additional scope of services detailed above is $425,863.

Options

1) Authorize the City Manager to execute Contract Amendment No. 4 on behalf of the City with Noll & Tam Architects for additional construction services necessary for the Los Altos Community Center construction project in the amount of $425,863 and up to a 20% contingency amount of $85,173 on behalf of the City, should additional amendments become necessary to address future unforeseen circumstances that could arise during construction.

Advantages: Allows necessary design modifications to be incorporated into the Community Center construction project and allows the design team to continue to provide critical services through project completion and closeout.

Disadvantages: None

2) Do not authorize the City Manager to execute an amendment with Noll and Tam Architects for professional services in the amount of $425,863.

Advantages: None

Disadvantages:

- Keeping the contracted during the Community Center's construction is of utmost importance to the City and the huge investment made to date in this community asset. The City needs the design team – architects and engineers – available to work alongside the contractor to assure the facility is constructed in accordance with the plans, specifications, and building codes.

Without the design team on-board, the City will be assuming an amount of risk that is well beyond staff's ability to manage and will impact quality control/assurance and result in ongoing delays that would cost the City at least $4,000 per day.

- Provision No. 13 in the City's contract with Noll and Tam Architects states that upon termination (without cause) the City is obligated to pay for all work up through termination.

Recommendation

The staff recommends Option 1.

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ADDITIONAL SERVICE REQUEST NO. 8

March 10, 2020

Peter Maslo
Project Manager, City of Los Altos
1 N. San Antonio Rd
Los Altos, CA 94022

NOVA PARTNERS INCORPORATED
Approved by: **Saul Flores**
Date: **April 15, 2020**
Amount: **$3,340**

Re: Revisions To Kinder prep

Dear Mr. Maslo,

Per City request, we are submitting an additional service request for design revisions to Kinderprep

Scope of Work:

- Add open shelving at North East Corner of the Space
- Eliminate Carpeting
- Revise Height of Window Sill
- Provide design for interior decoration of wall surfaces

Tasks:

- Attend 1 Meeting
- Revise Revit Model/Drawings
- Issue ASI 43

Deliverables:

ASI 43 consisting of floor plans, elevations and specification for homosote.

Fees: not to exceed value below, invoiced monthly.

Total ASR 8 Compensation:	
Noll & Tam Architects	$3,340.00
Consultants	$0.00
Total Additional Fee Requested	**$3,340.00**

Sincerely,

James Gwise — **date**
Project Manager — *3/10/2020*

Approved:

Peter Maslo 4/16/2020

Peter Maslo — **date**
Project Manager, City of Los Altos

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ADDITIONAL SERVICE REQUEST NO. 9

January 27, 2020

Peter Maslo
Project Manager
City of Los Altos
1 N. San Antonio Rd
Los Altos, CA 94022

NOVA PARTNERS INCORPORATED

Approved by: **JCJ**
Date: **Feb 25, 2020**
Amount: **$9,640**

Re: Fire Department revision to Standpipe System

Dear Mr. Maslo,

We submit this ASR for SCCFD requested revisions to approved Contract Documents. The Contract Documents assumed a building mounted standpipe system connected to the building fire suppression system. In a meeting with SCCFD on 12/18/19, SCCFD clarified that standpipes shall be independent of the building fire suppression system and required wharf hydrants located in the landscape, not the previously agreed building mounted standpipes.

Design team effort covered by this ASR includes preparing diagrams for the SCCFD meeting, meeting prep with G+S and its subcontractor, travel to Los Gatos to meet with SCCFD, preparation of meeting notes and revised concept diagram, design coordination (NT, BKF and MiG) to locate wharf hydrants in the landscape and Contract Document revisions (NT and BKF).

Fees:

Total ASR 9 Compensation:	
Noll & Tam Architects	$3,040.00
BKF	$6,600.00
Total Additional Fee Requested	**$9,640.00**

Sincerely,

Approved:

3/4/2020

James Gwise AIA — **date**
LACC Project Manager, N&T — *01/27/2020*

Peter Maslo — **date**
Project Manager, City of Los Altos

LACC ASR 9 – Fire Department revision to standpipe system

Noll and Tam Fee Schedule:

Item	Description	DP (rate: 140)		JG (rate: 170)	
1	Meeting and Meeting Prep	2	$280.00	5	$850.00
2	Meeting notes and revised concept diagram			3	$510.00
3	Document Revision	10	$560.00		
	N&T Subtotal	**12**	**$1680.00**	**8**	**$1360.00**
	N&T Total				**$3,040.00**

Consultant Fees

	BKF Fee (see next page)	$6,000.00
	N+T Consultant Coordination (10% markup)	$600.00
	Total Add Service Request	**$9,640.00**

ATTACHMENT 1

BKF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

January 15, 2020
BKF No. 20170208-11

Mr. James Gwise
Noll & Tam Architects
729 Heinz Avenue, #7
Berkeley, CA 94710
Email: james.gwise@nollandtam.com

SUBJECT: ADDITIONAL SERVICE REQUEST #04
LOS ALTOS COMMUNITY CENTER, LOS ALTOS

Dear James,

Thank you again for your continued use of BKF on your project. We would like to take this time to alert you to some additional services we are working on, which are outside of our original scope of work. The below additional scope items are the result of additional requirements from the Santa Clara County Fire Department (SCCFD).

TASK 1: Fire Sprinkler/Fire Water Revisions **Fee: $6,000**

Based on the LACC Fire Marshal Standpipe Review meeting held on December 18th, 2019, we understand SCCFD fire marshal rejected the proposed building standpipe layout for the community center is requiring design modifications. Feedback from the Fire Marshal indicates a requirement for separate wharf hydrants separate from the building system (this requirement is contrary to direction provided by the Fire Marshal early on in the project). BKF will modify the current conform drawing set to include the required changes outlined in the meeting notes provided by Noll & Tam and the final agreed upon wharf hydrant/sprinkler design. We will issue a design revision set for resubmittal to the city of Los Altos. Documents and further measures include:

- **Revised Civil Drawings** which alter the current approved plans to show the design revisions requested by the SCCFD. We will need to modify our permit drawings conformed set (sheets C2.1, C2.3, C3.1, and C4.1) to show the additional wharf hydrants, FDC, valves, and modified water utility routing with associated structures. Additional review of contractor submittals for this work is also included.

Please provide your acceptance of this Additional Service Request by signing below. Should you have any questions regarding the additional scope of services or fees, please do not hesitate to contact me at (650) 482-6457.

Very truly yours,
BKF ENGINEERS

Dale Leda, PE, QSD/QSP
Project Manager

cc: Roland Haga, PE, PLS
Vice President

Approved: ______________________________ ______________
James Gwise, Noll & Tam Architects Date

ATTACHMENT 1

18-4492 KB.

NOLL & TAM ARCHITECTS

ASR 09

December 3, 2018

Ms. Tracey Steiger
Santa Clara County Fire Department
14700 Winchester Blvd.
Los Gatos, CA 95032

RE: EVA and hose reach at the new Los Altos Community Center – standpipe proposals

Dear Ms. Steiger:

Per our discussions at 11/1/18 meeting at the city of Los Altos and follow up conference call on 11/6/18 we are providing 2 design options to achieve hose reach. Both design options utilize the following:

- (1) existing private fire hydrant (Fire Hydrant 1) at the northwest side of the site adjacent to the Bus Barn Theater;
- (1) new public fire hydrant (Fire Hydrant 2) at the north east corner of the new parking lot;
- (2) new wet standpipes providing coverage to the courtyard, east and north sides of the building. Each standpipe will be fitted with (2) 2 ½" threaded connections conforming to SCCFD requirements and will be fed from the building fire sprinkler system.

<u>**Fire Hydrant 2**</u>

Fire Hydrant 2 is proposed to be installed within 8'-0" of the parking lot curb and will have a 30' clear no parking zone in front of the hydrant. A portion of the no parking zone is shared with loading for the adjacent ADA van accessible parking space. The Loading zone is will be designated a no parking area and will not impact ability of the Fire Department to access Fire Hydrant 2.

RECEIVED

DEC 05 2018

SANTA CLARA COUNTY
FIRE DEPARTMENT

ASR 09

ATTACHMENT 1

FIRE DEPARTMENT
SANTA CLARA COUNTY
14700 Winchester Blvd., Los Gatos, CA 95032-1818
(408) 378-4010 •(408) 378-9342 (fax) • www.sccfd.org

PLAN REVIEW No. 18 4492

BLDG PERMIT No.

DEVELOPMENTAL REVIEW COMMENTS

Plans and Scope of Review:

This project shall comply with the following:

The California Fire (CFC) & Building (CBC) Code, 2016 edition, as adopted by the City of Los Altos Municipal Code (LAMC), California Code of Regulations (CCR) and Health & Safety Code.

The scope of this project includes the following:

Limited review of the proposed new City of Los Altos Community Center standpipe system.

Plan Status:

Fire Department Standpipe **Option 1** is **APPROVED** with the following conditions.

Plan Review Comments:

1. **Review of this Developmental proposal is limited to acceptability of site access, water supply and may include specific additional requirements as they pertain to fire department operations, and shall not be construed as a substitute for formal plan review to determine compliance with adopted model codes. Prior to performing any work, the applicant shall make application to, and receive from, the Building Department all applicable construction permits.**

2. The standpipe system shall be a manual primed wet system. The two identified standpipes in *Option #1* shall be supplied by a 4 head connection. The 4 head connection shall be placed within 100 feet of the public fire hydrant. *(Hydrant #2 on the drawing).* Please note that the FDC for the sprinkler system shall also be located within 100 feet of this public fire hydrant.

This review shall not be construed to be an approval of a violation of the provisions of the California Fire Code or of other laws or regulations of the jurisdiction. A permit presuming to give authority to violate or cancel the provisions of the fire code or other such laws or regulations shall not be valid. Any addition to or alteration of approved construction documents shall be approved in advance. [CFC, Ch.1, 105.3.6]

City	PLANS	SPECS	NEW	RMDL	AS	OCCUPANCY	CONST. TYPE	ApplicantName	DATE	PAGE
LOS	☐	☐	☐	☐	☐			Noll & Tam Architects	12/21/2018	1 OF 1

SEC/FLOOR	AREA	LOAD	PROJECT DESCRIPTION	PROJECT TYPE OR SYSTEM
			Commercial Development	Design Review

NAME OF PROJECT	LOCATION
LOS ALTOS COMMUNITY CENTER	97 Hillview Ave Los Altos

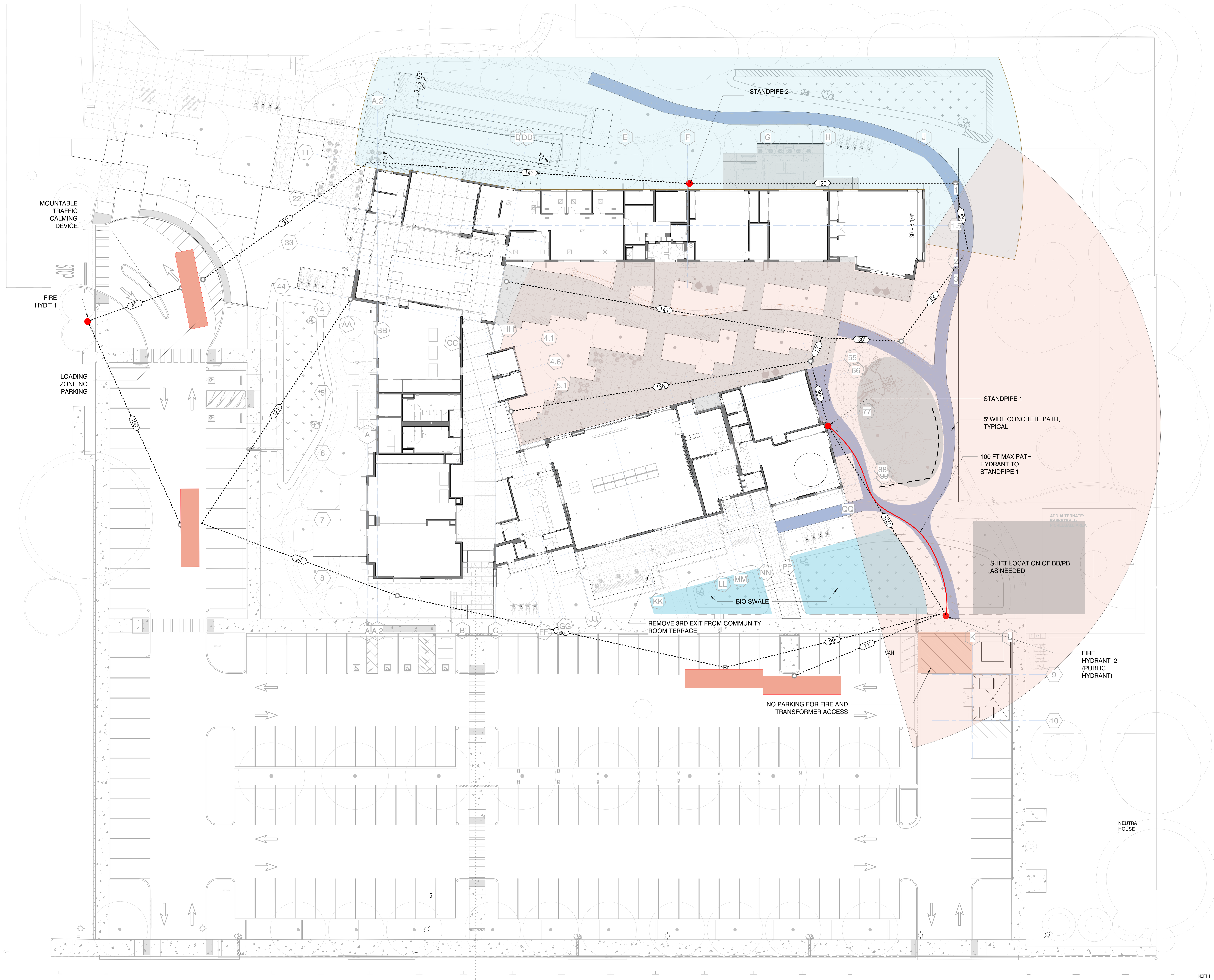
TABULAR FIRE FLOW	REDUCTION FOR FIRE SPRINKLERS	REQUIRED FIRE FLOW @ 20 PSI	BY
			Baker, Kathy

ATTACHMENT 1

NOLL & TAM
ARCHITECTS
729 Heinz Avenue
Berkeley, CA 94710
tel 510.542.2200
fax 510.542.2201

ARCHITECTS SEAL

DRAFT! NOT FOR CONSTRUCTION



1 D2.01 ZZ Site Landscape Working
1/16" = 1'-0"

C:\Users\dora.pollak\Desktop\REVIT LOCAL\LACC_Arch_Central_v2019_dora.pollak.rvt

1/10/2019 3:09:20 PM

PROJECT TITLE

City of Los Altos
Los Altos Community Center

97 Hillview Ave.
Los Altos, CA 94022

ISSUE TITLE
90% CONSTRUCTION DOCUMENTS

ISSUE DATE	01/11/19
NOLL & TAM JOB NUMBER	21730

REVISIONS

	DATE	DESCRIPTION

SHEET TITLE
SITE PLAN - FIRE ACCESS MODIFICATIONS

SHEET NUMBER
D2.01

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ADDITIONAL SERVICE REQUEST NO. 10

April 27, 2020

Peter Maslo
Project Manager
City of Los Altos
1 N. San Antonio Rd
Los Altos, CA 94022

NOVA PARTNERS INCORPORATED
Approved by: **Saul Flores**
Date: **Oct 16, 2020**
Amount: **$9,562.00**

Re: Access Control and Security Revision

Dear Mr. Maslo,

Per City request, we are submitting an additional service request for revisions to Access Control and Surveillance Scopes of work. This proposal includes the following activities:

1. Attend meetings and conference calls to discuss access control and surveillance on 12/11/2019 – Initial discussion; 12/18/2019 conference call to review LACC Security, 1/29/2020 on site meeting with City and Nova ;
2. Coordinate security and access revisions with architectural;
3. Coordinate door hardware revisions with hardware consultant and coordinate with contractor submittals;
4. Prepare and Issue ASI 26/ASI 26r1 issued 2/20/2020 (includes SFMI revision R2 to ASI 26);
5. Prepare and issue ASI 27- dated 2/27/2020, issued 3/2/2020.

Deliverables:

ASI 26 – Access Control; ASI 27 - Security

Fees

Total ASR 10 Compensation:	
Noll & Tam Architects	$3,490.00
SFMI	$6,072.00
Total Additional Fee Requested	**$9,562.00**

Sincerely,

James Gwise date
Project Manager *04/27/2020*

Approved:

Peter Maslo 4/27/2020

Peter Maslo **date**
Project Manager
City of Los Altos

NOLL & TAM ARCHITECTS

Los Altos Community Center

ADDITIONAL SERVICE REQUEST NO. 11

April 28, 2020

NOVA PARTNERS INCORPORATED

Approved by: **JCJ**
Date: **May 4, 2020**
Amount: **$194,480**

Peter Maslo
Project Manager,
Los Altos Community Center
City of Los Altos,
1 N. San Antonio Rd.
Los Altos, CA 94022

Re: Schedule Extension

Dear Mr. Maslo,

Per discussion with Nova partners., this add service request is to cover design team effort for a longer than anticipated construction period.

Noll and Tam's project fee proposal estimated a 12 to 14 month construction period. In comparison, the current G+S construction schedule shows the project spanning from Notice to Proceed issued on 9/3/19 to Substantial Completion date of 11/25/2020, a period of roughly 15 months.

The City awarded the construction bid on July 30 and Noll and Tam began Construction Administration activities 8/1/19 which, coupled with the contractor's 15 month construction schedule, lengthens our total Construction Administration phase to 16 months. We request the city consider a 3-month extension to bring Noll and Tam's fee into alignment with our Construction Administration efforts to date and the expected Substantial Completion date of 11/25/20. The current design fee budget for Closeout phase will cover the period between Substantial Completion and Final Completion date of 12/20/20.

Fees:

We propose an additional service to cover a schedule extension of 3 months which, barring circumstances beyond our control, should see us through project closeout. The proposed fee adjustment excludes costs incurred due to the current Shelter in Place Order (s) issued by state, and local governments.

The proposed fee, including consultants, is $194,480.00.

NOLL & TAM FEE BREAKDOWN 3 MONTH EXTENSION						
		Prin	PM	PA	Staff	
	Rate	$210.00	$170.00	$155.00	$140.00	Total
Month 1	**Hours**	**8.00**	**120.00**	**0.00**	**140.00**	**268.00**
Month 2	**Hours**	**16.00**	**120.00**	**0.00**	**140.00**	**276.00**
Month 3	**Hours**	**24.00**	**120.00**	**0.00**	**160.00**	**304.00**
Total Fee		**$10,080.00**	**$61,200.00**	**$0.00**	**$61,600.00**	**$132,880.00**

Consultants	Fee
Daedalus	$22,000.00
Integral	$13,200.00
OMM	$13,200.00
MIG	$13,200.00
Subtotal	**$61,600.00**
Grand Total	**$194,480.00**

Please contact me at your earliest convenience with questions or if additional supporting information is required.

A fee schedule is attached for your review.

Sincerely,

Approved:

James Gwise **date**
Project Manager *04/28/2020*

Peter Maslo **date**
Project Manager 10/16/2020
City of Los Altos

NOLL & TAM ARCHITECTS

April 28, 2020

Peter Maslo
LACC Project Manager
1 N. San Antonio Road
Los Altos, Ca 94022

RE: ASR 11 – Extended Construction Schedule.

Dear Peter,

As discussed with Nova, we are submitting the attached ASR 11 which requests additional fee for a longer than expected construction schedule Currently, without taking Covid 19 into account, we are projecting the construction administration phase to exceed our projections by 3 months.

As you consider this request, we think it helpful to provide you with a bit of project history so the City can understand the context of the request and our earnest approach to providing the City with design services.

The early design phases of the Community Center project experienced an intense amount of interest by City Council and the community. Noll and Tam worked with the City Council and stakeholders to refine the placement of the new building on the site and develop a successful concept/schematic design. These efforts became tangible at the 9/11/17 City Council meeting when the council voted to increase the project budget resulting in expanded building area, elevated building quality and site expansion to include the Library Connector.

Noll and Tam submitted Add Service 1 on 6/20/18 requesting design fees to cover the expanded scope and included a limited amount of additional fee for construction administration phase. ASR1 did not propose any changes or adjustments to the project schedule to compensate for additional effort implied in the elevated quality and expanded project scope

ASR1 was authored prior to the completion of Design Development phase and did not capture continuing adjustments to the design including revisions to the site plan (examples are removal of the basketball court, redesign of entry plaza and fire department access studies) which came from stakeholder, commission and fire department reviews occurring between July of 2018 and May of 2019.

Our efforts in the design and documentation phases required more time than anticipated. The original schedule for the design phases, SD through CD was exceeded by 8 months. We have absorbed this additional effort and only mention it here to provide perspective as we plan our design team's effort toward the completion of construction.

The transition from construction document phase to Bidding and Construction Administration was complicated by the departure of important city staff (head of the DPW, City Engineer and City's Project Manager), late procurement of Nova, the project's Construction Manager, and a late constructability review which occurred after application for building permit.

The Bidding and CA phases are anticipated to exceed our original planning assumptions by approximately 3 months (as noted in ASR11) and the overall project duration will have extended approximately 1 year longer.

We are currently seven months into the Construction Administration phase, and we see project needs exceeding the level of effort anticipated in Noll and Tam's contract as amended by ASR1. Our estimated hours described in ASR 11 for an extended CA duration are based on a similar level of effort.

For example, as you will remember, the primary tasks that have required additional attention in the last few months include:

1. Review of Contractor substitution requests:
   The project bid documents stipulated that requests for material substitutions will not be accepted after bid date. Shortly after award of contract, in the spirit of cooperation, the design team agreed to make an exception to the substitution rule and review a limited number of substitution requests, agreeing to review a limited scope of 7 substitution requests. To date, we have reviewed 16 substitution requests.

2. Additional facilitation of submittal review and processing
   Noll and Tam expended additional hours than typically required to provide leadership and assistance in expediting key submittals in order to maintain project schedule:
   - Fire Protection (sprinklers) – multiple reviews and coordination assistance to the contractor to expedite Fire Department review and approval
   - Structural Steel – multiple reviews in a fast track format to maintain contractor's schedule
   - Concrete curb – unanticipated submittal, reviewed and issued an ASI for detailed coordination of curbs and other architectural elements.

Noll and Tam has been attentive to the needs of the City and the Contractor throughout the course of the project from the early stages of design through our current activities in the Construction

Administration phase; approval of ASR 11 will support our continued services in this longer than anticipated construction period.

Please contact me at your earliest convenience to discuss and/or if you need additional information to assist with your review of this request.

Best Regards,

James Gwise AIA Architect, Associate
LACC Project Manager

CC: Janet Tam/N+T, Saul Flores/Nova, Joe Caps-Jenner/Nova

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ADDITIONAL SERVICE REQUEST NO. 12

May 13, 2020

NOVA PARTNERS INCORPORATED

Approved by: **Sam Tooley**
Date: **May 27, 2020**
Amount: **$29,301**

Type text here

Peter Maslo
Project Manager
City of Los Altos
1 N. San Antonio Rd
Los Altos, CA 94022

Re: Extension to Geotechnical Services

Dear Mr. Maslo,

Per City request, we are submitting an additional service request for extended Geo Technical Services.

Please see the attached work sheet for services provided. These services will be provided on a time and materials basis and not to exceed the specified sum without prior approval from the City of Los Altos.

Fees

Total ASR 12 Compensation:	
Cal Engineering and Geology	$26,638.00
Noll and Tam Administrative Fee	$2,663.00
Total Additional Fee Requested	**$29,301.00**

Sincerely,

James Gwise — **date**
Project Manager — *05/13/2020*

Approved:

5/28/2020

Peter Maslo — **date**
Project Manager
City of Los Altos

Attached:

1) 171980-HillviewCommCenter-CostProjections-CEG-Lab-Field Testing_20200325
2) CE&G Rate Schedule 2020

CE&G
Cal Engineering & Geology

Cost Projections for Additional Testing Services
Hillview Community Center
Los Altos, CA

ATTACHMENT 1

March 26, 2020
prepared by: D. Peluso, P.E.
Principal Engineer/GE
prepared for: Noll Tam

TABLE 1 - LEVEL OF EFFORT AND COST PROJECTIONS

Project Assumptions/Limitations

We are providing cost projections based on a discussion with the general contractor regarding the remaining portions of the work items that we are anticipated, which include compaction testing of the following project components: underground utility trench backfill, pavement area subgrade and AB, trash enclosure and transformer pad, and library connector. We anticipate several laboratory compaction curves will also be

Note: We have assumed regular time at prevailing wage where applicable (i.e. no overtime or weekends).

Task 1: Project Management, Coordination, QC

Scope and purpose: Overall project management; coordinate efforts with general contractor and Noll & Tam; review project documents; dispatch; review test results/DFR's; provide overall quality control (~2-4 hrs for every week of field time).

Principal Engineer (office)	20 hr	$	240 /hr	$	4,800.00
			Task 1 Subtotal	*$*	*4,800.00*

Task 2: Compaction Testing for Underground Utilities

Field Technician (field + travel)	4 hr	$	130 /hr	$	520.00
Nuclear gage	1 ea	$	56 /day	$	56.00
Reimbursables (mileage to/from jobsite & Hayward lab)	60 mi	$	.58 /mi	$	34.50
Field Technician (office; complete & upload dailies)	.5 hr	$	130 /hr	$	65.00
Subtotal per Visit				$	675.50
Estimated No. of Visits					10 visits
			Task 2 Subtotal	*$*	*6,755.00*

Task 3: Compaction Testing for Pavement Areas - Subgrade and AB

Field Technician (field + travel)	4 hr	$	130 /hr	$	520.00
Nuclear gage	1 ea	$	56 /day	$	56.00
Reimbursables (mileage to/from jobsite & Hayward lab)	60 mi	$	.58 /mi	$	34.50
Field Technician (office; complete & upload dailies)	.5 hr	$	130 /hr	$	65.00
Subtotal per Visit				$	675.50
Estimated No. of Visits					8 visits
			Task 3 Subtotal	*$*	*5,404.00*

Task 4: Compaction Testing for Trash Enclosure and Transformer Pad

Field Technician (field + travel)	4 hr	$	130 /hr	$	520.00
Nuclear gage	1 ea	$	56 /day	$	56.00
Reimbursables (mileage to/from jobsite & Hayward lab)	60 mi	$	.58 /mi	$	34.50
Field Technician (office; complete & upload dailies)	.5 hr	$	130 /hr	$	65.00
Subtotal per Visit				$	675.50
Estimated No. of Visits					2 visits
			Task 4 Subtotal	*$*	*1,351.00*

[continued next page]

CE&G
CAL ENGINEERING & GEOLOGY

Cost Projections for Additional Testing Services
Hillview Community Center
Los Altos, CA

ATTACHMENT 1
March 26, 2020
prepared by: D. Peluso, P.E.
Principal Engineer/GE
prepared for: Noll Tam

Task 5: Compaction Testing for Library Connector					
Field Technician (field + travel)	4 hr	$	130 /hr	$	520.00
Nuclear gage	1 ea	$	56 /day	$	56.00
Reimbursables (mileage to/from jobsite & Hayward lab)	60 mi	$	.58 /mi	$	34.50
Field Technician (office; complete & upload dailies)	.5 hr	$	130 /hr	$	65.00
Subtotal per Visit				$	675.50
Estimated No. of Visits					7 visits
			Task 5 Subtotal	*$*	*4,728.50*
Task 6: Obtain Bulk Samples for Fill Placement - Soil					
Field Technician (field + travel)	2 hr	$	130 /hr	$	260.00
Reimbursables (mileage to/from jobsite & Hayward lab)	60 mi	$	.58 /mi	$	34.50
Compaction Curve (4" mold)	1 ea	$	257 /ea	$	257.00
Subtotal per Visit				$	551.50
Estimated No. of Visits/Samples					1 visits
			Task 6 Subtotal	*$*	*551.50*
Task 7: Obtain Bulk Samples for Fill Placement - AB					
Field Technician (field + travel)	2 hr	$	130 /hr	$	260.00
Reimbursables (mileage to/from jobsite & Hayward lab)	60 mi	$	.58 /mi	$	34.50
Compaction Curve (6" mold)	2 ea	$	317 /ea	$	634.00
Subtotal per Visit				$	928.50
Estimated No. of Visits/Samples					1 visits
			Task 7 Subtotal	*$*	*928.50*
Task 8: Prepare Final Testing/Conformance Letter					
Principal Engineer (office)	4 ea	$	240 /hr	$	960.00
Staff Engineer (office)	8 ea	$	145 /hr	$	1,160.00
			Task 8 Subtotal	*$*	*2,120.00*
			Total Estimate (Tasks 1-8)	**$**	**26,638.50**

CE&G
Pragmatic Expertise™

Schedule of Charges 2020

Personnel	2020	Rates/Units
Senior Principal Engineer/Geologist	$ 280	per hour
Principal Engineer/Geologist	$ 240	per hour
Associate Engineer/Geologist	$ 215	per hour
Senior Engineer/Geologist	$ 200	per hour
Project Engineer/Geologist	$ 160	per hour
Staff Engineer/Geologist	$ 145	per hour
Technician (Straight rate prevailing wage)	$ 130	per hour
Senior GIS/CADD Specialist	$ 140	per hour
GIS/CADD Specialist	$ 125	per hour
UAS Manager	$ 155	per hour
Project Assistant	$ 95	per hour
Administration/Clerical	$ 85	per hour
Special Inspector (Straight rate prevailing wage; no 4-hr min)	$ 135	per hour
Deposition/Court Testimony (minimum 4 hours)	$ 400	per hour

Field and Laboratory Tests	2020	Rates/Units
Concrete Compressive Strength Testing	$ 39	per cylinder
Moisture Content (ASTM D 2216)	$ 23	per test
Moisture & Density (ASTM D 4318)	$ 31	per test
Atterberg Limits (ASTM D 4318)	$ 202	per test
Compaction Curve, 4" mold (ASTM D 1557)	$ 257	per test
Compaction Curve, 6" mold (ASTM D 1557)	$ 317	per test
Wash over #200 Sieve (ASTM D 1140)	$ 71	per test
Sieve Analysis with #200 Wash (ASTM D 422)	$ 148	per test
Sieve & Hydrometer (ASTM D 422)	$ 229	per test

Reimbursables	2020	Rates/Units
Mileage (per allowable federal)	$0.58	per mile
Nuclear Gage	$ 57	per day
Inclinometer	$ 196	per day
Vane Shear Device	$ 113	per day
UAS Equipment	$ 361	per day
GNSS Mapping Equipment	$ 206	per day

1. **Professional Services -** These are "all-up" rates, and include direct salary cost, overhead, general and administrative costs not separately accounted for, and profit. They shall remain in effect through December 31, 2020. Ongoing work continuing beyond December 31, 2020 will be invoiced at the applicable new year's rate.
2. **Travel Time -** Travel time will be charged at regular hourly rates, not to exceed eight (8) hours per day.
3. **Expenses -** All direct costs will be billed at actual cost plus 10%, unless there is explicit agreement otherwise. Direct costs include:
   - Third party services – Fees for subcontracted third party services (including drilling and backhoe services, special consultant fees, permits, special equipment rental, overnight mail or

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messenger services and other similar project related costs)

- Travel expenses, including airfares, hotel, meals, ground transportation, and miscellaneous expenses.
- Reproduction costs, including photocopy, blueprints, graphics, photo prints or printing.

4. **Subconsultants -** To the extent that it becomes necessary to use subconsultants, Client will be invoiced at cost plus 10% to cover insurance liability and other overhead costs.
5. **Accounting -** The cost of normal accounting services for invoicing has been considered in the overhead expense which is included in the above hourly rates. Additional requirements for invoice verification, such as copies of time sheets, detailed expense records, and supplemental daily work justification will be billed on an hourly basis.

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ADDITIONAL SERVICE REQUEST NO. 13

July 9, 2020

Peter Maslo
Project Manager
City of Los Altos
1 N. San Antonio Rd
Los Altos, CA 94022

NOVA PARTNERS INCORPORATED
Approved by: **Saul Flores**
Date: **July 10, 2020**
Amount: **$6,620.00**

Re: Addition of Graphics to Signage

Dear Mr. Maslo,

Per City request, we are submitting an additional service request for the addition of graphics to interior signage and adjustment of room names as requested by the City. Please contact me at your earliest convenience with questions and comments regards this request

Fees

Total ASR 12 Compensation:	
Square Peg (see attached)	$5,000.00
Noll and Tam additional time (8 hours at $140/hour)	$1,120.00
Noll and Tam Administrative Fee	$500.00
Total Additional Fee Requested	**$6,620.00**

Sincerely,

James Gwise — **date**
Project Manager — *07/09/2020*

Approved:

10/23/2020

Peter Maslo — **date**
Project Manager
City of Los Altos

Attached: LACC SQP Add Service 2020-0630

SQPEG

ADD SERVICE AGREEMENT

DATE	June 30th, 2020
CLIENT	Noll & Tam
SQPEG PROJECT	20025
PROJECT NAME	Los Altos Community Center
ADD SERVICE	#01: Hand Drawn Illustrations & Additional Construction Administration Services

SCOPE REVISION

1: Ten (10) Hand-drawn Illustrations
Square Peg Design has been asked to provide illustrations for room identification flag signs at the Los Altos Community Center (LACC) project. The work includes development of ten (10) hand drawn illustrations including:

(1) Oak Leaf & Acorn at Grand Oak Room
(1) Cedar Leaf at Cedar Lounge
(1) Coffee Cup at Café
(1) Manzanita Leaf at Manzanita Room
(1) Sequoia Leaf at sequoia Room
(1) Apricot & Leaf at Apricot Room
(1) Chair/Sofa at Teen Lounge
(1) Dancer at Movement Room
(1) Paint Brush/Easel at Arts & Crafts
(1) Sycamore Leaf at Sycamore Room

Square Peg will provide one set of illustrations for review with Noll & Tam, one (1) set of revisions based on Noll & Tam feedback, one (1) set of illustrations for LACC's review, and one (1) set of final artwork applied to final sign layout artwork for submittal to the sign fabricator for production. All design review meeting will be via internet conference call.

Ten (10) Hand-drawn Illustrations as per above . . . . ADD $ 2,400

2: Additional Construction Administration Services
Square Peg Design has exceeded our expected Construction Administration (CA) fee for the Los Altos Community Center project due to additional shop drawing review and design revisions. Additional fee is required to complete the project. The additional time will be used to cover addition shop drawing reviews, shop drawing reviews, on-site review of prototypes, and on-site review of sign installation.

Additional CA Services Fees Billed Hourly Not To Exceed. . . . . ADD $ 2,600

NET TOTAL ADD $ 5,000

APPROVED BY ______________________________ DATE ______________

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ASR #14R1

October 15, 2020

NOVA PARTNERS INCORPORATED

Approved by: **Saul Flores**
Date: **Oct 16, 2020**
Amount: **$141,000.00**

Peter Maslo
Project Manager
City of Los Altos
1 N. San Antonio Rd
Los Altos, CA 94022

Re: Additional Service Request #14R1, Covid19 Project Schedule Extension

Dear Mr. Maslo,

We respectfully submit this additional service proposal associated with the Covid19 Shelter in Place Order, which covers a roughly 2 ½ month period beginning March 17 and ending June 5. During this period, G+S ceased field operations and continued pre-construction activities, extending the construction schedule by approximately 2 ½ months. In addition to the roughly 2 ½ month cessation of field activities, the contractor is requesting and extension to the construction schedule attributed to inefficiencies caused by Covid site protocols. Per your request we are updating our additional service request to account for the rescheduling of substantial completion and additional CA activities stemming from Covid inefficiencies. Substantial completion is re-scheduled from 11/25/20 to the 3/21/21, per G+S's August 2020 Construction Schedule.

With the contractor continuing pre-construction activities, the design team continued its Construction Administration activities without cessation, processing submittals, RFI's and attending weekly and special meetings. With the extension of the project schedule, the design team's Construction Administration phase is extended for 3 ½ months.

The proposal's fee calculation is based on Noll and Tam's average of hours consumed while the Shelter in Place Order was in effect. We have allocated an additional $15,000 for consultant fees. Additional fee is proposed for consultant activities associated with the delay of substantial completion which has moved from 11/25/20 to 3/25/21, a period of 3.5 months. We expect that MiG, OMM and Integral will have their CA activities extended beyond the dates anticipated in ASR11 which forecast a substantial completion date of 11/25/20.

We propose a total fee of $141,000.00 for Noll+Tam and Design Consultants; see the next page for the fee breakdown. Please contact me at your earliest convenience with questions or comments regarding this proposal.

Sincerely,

James Gwise **date**
Project Manager *10/15/20*

Approved:

10/16/2020

Peter Maslo **date**
Project Manager
City of Los Altos

Fees

Noll and Tam	Hrs/Mth	Mths	Total Hrs	Rate	Fee
Dora	154	3.5	539	140	75,460.00
James	80	3.5	280	170	47,600.00
Janet	4	3.5	14	210	2,940.00
Subtotal					**126,000.00**

Consultants	
Mig	5,000.00
IG	5,000.00
OMM	5,000.00
Total Consultant Fee	15,000.00
Total Fee: Noll+Tam and Consultants	**141,000.00**

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ASR #15-IRRIGATION CONTROLLER

July 27, 2020

NOVA PARTNERS INCORPORATED

Approved by: **Saul Flores**
Date: **July 29, 2020**
Amount: **$14,640.00**

Peter Maslo

Project Manager, City of Los Altos

1 N. San Antonio Rd Los Altos, CA 94022

Re: Additional Service Request #15 Irrigation Controller

Dear Mr. Maslo,

We respectfully submit this additional service proposal for design services associated with design and construction administration of new irrigation controllers serving the Base Ball field and the Soccer Field. We propose a total fee of $14,640.00 for Design Consultants with a modest amount of time for Noll + Tam's document coordination effort . The terms of OMM proposal is " hourly, not to exceed". Similarly, we've budgeted BKF hours in event their services are required otherwise their time will not be invoiced.

Please contact me at your earliest convenience with questions or comments regarding this proposal.

Fees

Noll and Tam	Total Hrs	Rate	Fee
Dora Pollak	4	140	560.00
Subtotal			**560.00**
Consultants			
MiG			8,580.00
OMM			3,300.00
BKF			2,200.00
Total Consultant Fee			**14,080.00**
Total Fee Noll+Tam and Consultants			**14,640.00**

Sincerely,

James Gwise date
Project Manager *07/27/2020*

Approved:

7/30/2020

Peter Maslo date
Project Manager
City of Los Altos

Attached: MiG Proposal 7/19/20; OMM Proposal 7/17/20

MIG

Janet Tam & James Gwise
Noll & Tam Architects
792 Heinz Avenue, #7
Berkeley, CA 94710

July 19, 2020

RE: Los Altos Community Center

Dear Janet and James:

As requested, this letter is provided to request **additional irrigation design services** for the Los Altos Community Center project. The level of effort listed below is in response to the specific scope of work noted in James' July 8th email.

Additional scope and fee to be added to Construction Administration:

- (2) site visits, travel time and field notes
- Coordination with the N&T and the City's representative
- Coordination with civil consultant, electrical consultant for power locations and Rain Master representative
- Revisions to the legend, plans and details
- (2) zoom meetings

Total for above...$7,800

We expect the above work could be completed within 2 weeks of a Notice to Proceed. Thank you and we look forward to completion of the Los Altos Community Center in the near future.

Sincerely,

Melissa Erikson
Principal, Director of Landscape Architecture

O'MAHONY & MYER
ELECTRICAL ENGINEERING & LIGHTING DESIGN

San Rafael, California
Pacific Harbour, Fiji

Brian O'Mahony
Jan P. Myer
Paul Carey
Pieter Colenbrander
Galway O'Mahony
David Orgish

July 17, 2020

Noll & Tam Architects
729 Heinz Ave. #7
Berkeley, CA 94710

Attn: James Gwise

Re: Hillside Community Center – Irrigation Controllers

Dear James,

As requested, we have prepared an additional services proposal to design the power circuits to the Soccer Field and Baseball Field Irrigation Controllers.

<u>Basic Assumptions:</u>

- The irrigation controllers will be connected to the new community center.
- Our scope of work excludes the design of the irrigation control low voltage wiring and data connections.

<u>Scope of Work:</u>

1. Revise the electrical site plan.
2. Add branch circuits to the two irrigation controllers.
3. Update panel schedules.

We propose to provide the above listed Electrical Engineering Services for a fee for $3,000 Hourly not Exceed.

Thank you again for the opportunity to submit this proposal. Please give me a call if you have any questions.

Sincerely,

Paul Carey

Paul Carey
Principal
O'Mahony & Myer

4340 Redwood Hwy., Suite 245 San Rafael, California 94903 Phone 415-492-0420 Fax 415-479-9662 www.ommconsulting.com

ATTACHMENT 1

NOLL & TAM ARCHITECTS

Los Altos Community Center

ASR #16- EXTERIOR LIGHING + SCULPTURE

October 15, 2020

NOVA PARTNERS INCORPORATED

Approved by: **Saul Flores**
Date: **Oct 16, 2020**
Amount: **$17,280.00**

Peter Maslo

Project Manager, City of Los Altos

1 N. San Antonio Rd Los Altos, CA 94022

Re: Additional Service Request #16 Exterior Lighting and Sculpture Foundati

Dear Mr. Maslo,

We respectfully submit this additional service proposal for design services associated with design and construction administration for addition of flagpole lighting, receptacles serving holiday decorations and placement of exterior sculpture. The general scope of work for each of these items:

1. Flagpole: Selection and design of light fixture placement on flagpole; circuiting of light fixture and integration with lighting controls
2. Exterior 110v receptacles serving decorative holiday lighting: design studies locating receptacles; documentation of receptacle location and circuiting.
3. Sculpture placement: design studies locating three sculptures in the landscape per Donna Legge email of 8/28/20.

For the above scope, we propose a total fee of $ 17,280.00. Please note that James' hourly rate is adjusted and the consultant fee listed includes our standard 10% markup.

Please contact me if you have questions or need additional information.

Sincerely,		Approved:	
			10/16/2020
James Gwise	**date**	**Peter Maslo**	**date**
Project Manager	*10/16/20*	*Project Manager*	
		City of Los Altos	

Attached: OMM Proposal, DSE Email, Legge Email

Fee Schedule:

Noll and Tam Hours

Sculpture Placement			
Dora Pollak	140	12	1,680
James Gwise	180	4	720
			2,400

Flag Pole Lighting			
Dora Pollak	140	4	560
James Gwise	180		0
			560

Exterior Holiday Lighting			
Dora Pollak	140	8	1,120
James Gwise	180	2	360
			1,480

Total Fee NT + Consultants:

Sculpture Art	
Noll + Tam	2,400
OMM	4,950
DSE	3,300
Total	**10,650**

Flagpole Lighting	
Noll + Tam	560
OMM	2,750
Total	**3,310**

Exterior Holiday Lighting	
Noll + Tam	1,120
OMM	2,200
Total	**3,320**

Total Request	**17,280**

ATTACHMENT 1

O'MAHONY & MYER

ELECTRICAL ENGINEERING & LIGHTING DESIGN

San Rafael, California
Pacific Harbour, Fiji

Brian O'Mahony
Jan P. Myer
Paul Carey
Pieter Colenbrander
Galway O'Mahony
David Orgish

October 6, 2020

Noll & Tam Architects
729 Heinz Ave. #7
Berkeley, CA 94710

Attn: James Gwise

Re: Hillview Community Center – Exterior Lighting Additions Proposal

Dear James,

As requested, we have prepared an additional services proposal for the following exterior lighting additions:

- Sculpture lighting.
- Flagpole Lighting.
- Christmas lighting tree receptacles.

Scope of Work:

1. Prepare art lighting design for two sculpture pieces, the Scissors, and the Dancing Man. We understand the Tower is internally illuminated and is excluded from our lighting scope of work. Scope of work will include branch circuiting and lighting control design.
2. Flagpole lighting: prepare flagpole lighting design, branch circuiting and controls.
3. Christmas tree lighting receptacles: design receptacles, branch circuiting and controls. Our scope of work excludes the design and specification of the Christmas three lighting.

We propose to provide the above listed Electrical Engineering Services (hourly not to exceed basis) for the following fees:

Sculpture Art Lighting:	$4,500
Flagpole lighting:	$2,500
Christmas Tree Receptacles:	$2,000

Thank you again for the opportunity to submit this proposal. Please give me a call if you have any questions.

Sincerely,

Paul Carey

Paul Carey
Principal
O'Mahony & Myer

James Gwise

Subject: FW: Updated Art Placement at Community Center

From: Mae Kawamoto <mkawamoto@daedalus-eng.com>
Sent: Thursday, October 8, 2020 6:17 PM
To: James Gwise <james.gwise@nollandtam.com>
Cc: Dora Pollak <dora.pollak@nollandtam.com>
Subject: RE: Updated Art Placement at Community Center

James,

Thanks for asking about supporting these art pieces.
As I mentioned on the phone, we can get these done pretty quickly – I would guess once the info is collected, within a day.
Some things we'd need to know, if it's available: sculpture center of gravity (or dimensions & weights of components so we can determine), base connection configuration and material, elevation of plinth if any (i.e. is there paving? is it raised above grade?). I think that's about it.

For this scope of work, DSE proposes a fixed fee of-$3,000.

Please let me know if you need more clarity.

Thanks.

Mae R. Kawamoto, P.E., S.E.

DAEDALUS
STRUCTURAL ENGINEERING

12930 Saratoga Avenue, Suite B9, Saratoga, CA 95070
O 408.517.0373 D 408.502.8964 C 510.427.8713

From: James Gwise <james.gwise@nollandtam.com>
Sent: Tuesday, October 6, 2020 5:31 PM
To: Mae Kawamoto <mkawamoto@daedalus-eng.com>
Cc: Dora Pollak <dora.pollak@nollandtam.com>
Subject: FW: Updated Art Placement at Community Center

Hi Mae,

The city will install sculpture pieces in the LACC Landscape and so we need to have foundation engineering for two of the pieces: Dancing Man and Conversation piece. Can you give some consideration to fee for providing a simple foundation? I image a concrete slab buried below grade with anchors similar in concept to the footing provided for the Tower (attached).

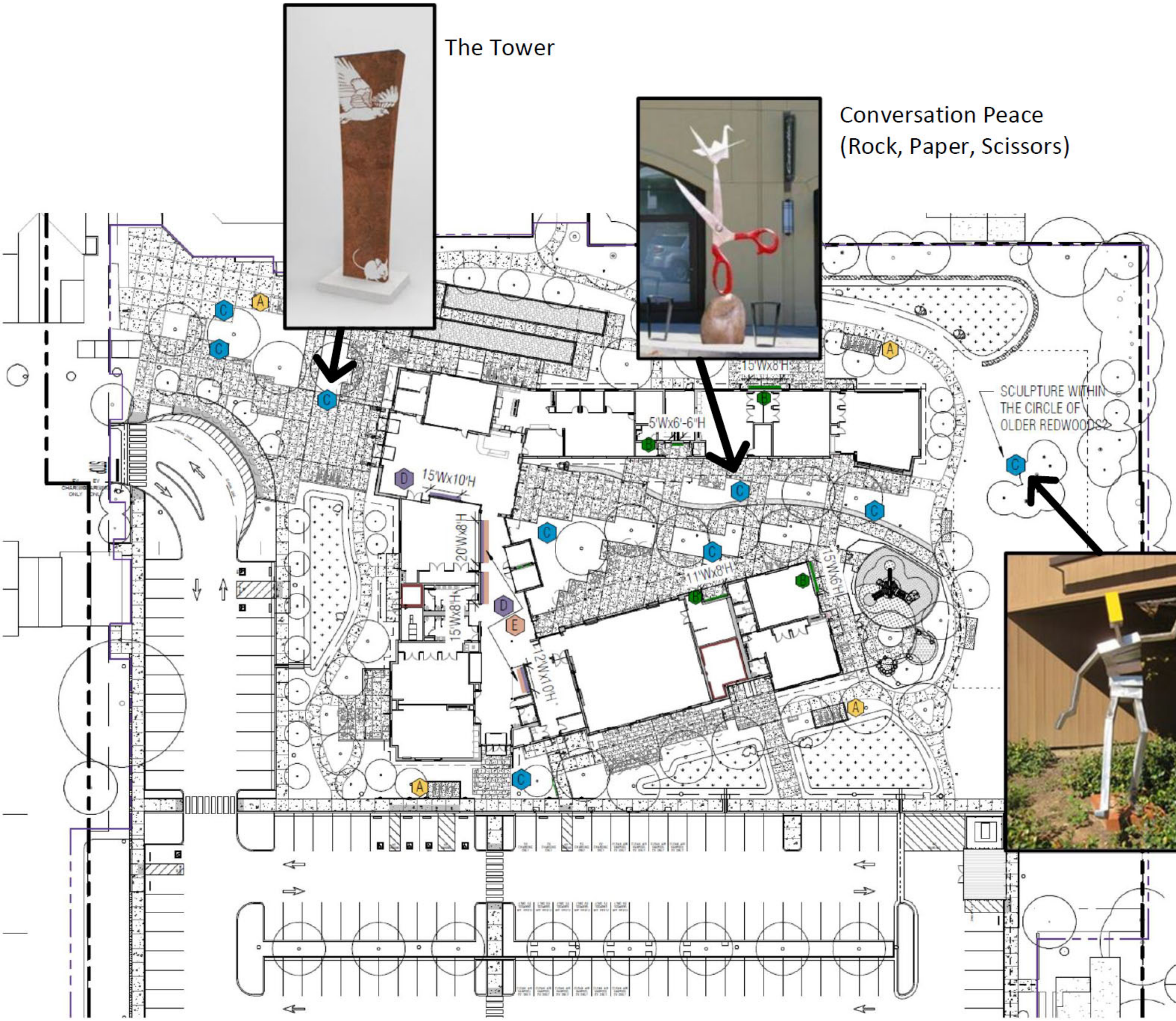
Thank you,
James

From: Donna Legge <dlegge@losaltosca.gov>
Sent: Friday, August 28, 2020 9:09 AM
To: James Gwise <james.gwise@nollandtam.com>
Cc: Dora Pollak <dora.pollak@nollandtam.com>; Peter Maslo <pmaslo@losaltosca.gov>; Joe Capps-Jenner <joecj@novapartners.com>; Saul Flores <saul@novapartners.com>; Dave Brees <DBrees@losaltosca.gov>; Manuel Hernandez <mhernandez@losaltosca.gov>
Subject: Updated Art Placement at Community Center

James,

Here is the information we have so far. As soon as I can get the weight of the Tower, I will forward. Let me know if you have other questions.

-Conversation Peace: 600 lbs, 84” x 36” x 24” – installation requires four 5.5” anchors in the concrete
-Dancing Man: 82in tall, 55in at the widest point, current base is 24x28. Weight estimated to be between 100-150 lbs.
-The Tower: weight unknown, 144” x 36” x 36” – requires 110V power for actual sculpture



8/25/2020 1:42:41 PM

City of Los Altos
Los Altos Community Center

POTENTIAL ART LOCATIONS - SITE PLAN

Although our offices are closed, we are continuing to serve the public remotely. Feel free to call or email the City for questions as many services have been modified. We thank the community for their cooperation and understanding. We can slow the spread of COVID-19 when we work together.

For more information on COVID-19, call 211 or text 'coronavirus' to 211211. Looking to donate or volunteer? Please visit https://www.csacares.org.

NOLL & TAM ARCHITECTS

MEETINGS-COVID

Project: Los Altos Community Center			Project: 21730
Covid Index	Date	Meeting	Comment
1	16-Mar	Weekly Meeting with Nova to review activities	
2	18-Mar	Weekly Owner Architect Meeting	
3	18-Mar	Weeklay Owner Architect Contractor Meeting	
4	23-Mar	Weekly Meeting with Nova to review activities	
5	24-Mar	Meet with City, Nova, SFMI - ASI 26/27 Security Intrusion Detection	
6	25-Mar	Weekly Owner Architect Meeting	
7	25-Mar	Weeklay Owner Architect Contractor Meeting	
8	26-Mar	Drywall Pre-construction meeting	
9	27-Mar	Painting Pre-Construction meeting	
10	30-Mar	Weekly Meeting with Nova to review activities	
11	31-Mar	Wood Ceiling pre-construction	
12	1-Apr	Weekly Owner Architect Meeting	
13	1-Apr	Weeklay Owner Architect Contractor Meeting	
14	1-Apr	Zoom Meeting with Donna Legge	
15	3-Apr	Commissioing Pre-con	
16	6-Apr	Weekly Meeting with Nova to review activities	
17	8-Apr	Weekly Owner Architect Meeting	
18	8-Apr	Weeklay Owner Architect Contractor Meeting	
19	8-Apr	Community Center Art	
20	10-Apr	Emergency Power meeting	NOVA,OMM,NT
21	13-Apr	Weekly Meeting with Nova to review activities	
22	15-Apr	Weekly Owner Architect Meeting	
23	15-Apr	Weeklay Owner Architect Contractor Meeting	
24	16-Apr	Site Concrete Pre-con	
25	27-Apr	Weekly Meeting with Nova to review activities	
26	27-Apr	Insulation Pre-con	
27	27-Apr	Cooordination review	Nova/NT
28	28-Apr	MEP Coordination	NT/NOVA/G+S
29	29-Apr	Weekly Owner Architect Meeting	
30	29-Apr	Weeklay Owner Architect Contractor Meeting	
31	29-Apr	Food Service Pre-Con	NT/NOVA/G+S/Marshall Assocaites/EBRS
32	30-Apr	Landscape Zoom	NT/NOVA/Jim Sandoval/Manny Hernandez
33	4-May	Weekly Meeting with Nova to review activities	
34	6-May	Weekly Owner Architect Meeting	
35	6-May	Weeklay Owner Architect Contractor Meeting	
36	7-May	Weekly Meeting with Nova to review activities	
37	12-May	Fire Sprinkler Coordination	NT/NOVA/G+S/RCM
38	12-May	Pay app review	NT/NOVA/G+S
39	13-May	Generator Meeting	
40	13-May	History Museum Meeting	
41	13-May	Weeklay Owner Architect Contractor Meeting	
42	14-May	Mockup review - flashing	
43	18-May	Weekly Meeting with Nova to review activities	
44	19-May	PV system review	NT/Nova/G+S/OMM

NOLL & TAM ARCHITECTS

MEETINGS-COVID

Project: Los Altos Community Center			Project: 21730
Covid Index	Date	Meeting	Comment
45	20-May	Weekly Owner Architect Meeting	
46	20-May	Weeklay Owner Architect Contractor Meeting	
47	20-May	Mockup review - flashing	
48	22-May	PV Charger Meeting	NT/COLA/Nova
49	25-May	Weekly Owner Architect Meeting	
50	26-May	Pay app review	NT/Nova/G+S
51	27-May	Weekly Owner Architect Meeting	
52	27-May	Weeklay Owner Architect Contractor Meeting	

ATTACHMENT 2

NOLL & TAM ARCHITECTS

SUBMITTAL LOG - COVID

Project:	Project Number:	Last Updated:
Los Altos Community Center	21730.00	10/15/2020

Pending	0	Total:	82	Resubmittal Required	1
Returned	82				

Index	Completed	Status	Submittal #	Date Received by N&T	Spec Section #	Section Title	Additional Description	Product Data	Samples	Shop Drawings	Schedules	LEED	Other	Forward to	Date Sent	Date Back	Date Returned to Contractor	No Exceptions	Make Corrections	Submit Item	Revise & Resubmit	Rejected	Resubmitted	Items to Resubmit	Comments
1			09 78 26.01	03/23/20	09 78 26	Wood Veneer Wall Panels	sample		x								03/31/20	x							
2			09 78 26.02	03/23/20	09 78 26	Wood Veneer Wall Panels	shop drawings			x							04/06/20				x				NOTE: this resubmittal is missing from Procore (fabric wall panels had been submitted under incorrect number). Is still outstanding R&R
3			06 41 00.02.A	03/24/20	06 41 00	Architectural Wood Casework	product data	X									04/16/20	X							
4			06 83 16.03	03/24/20	06 83 16	Fiberglass Reinforced Paneling			X								03/24/20	x							
5			09 90 00.02.B	03/24/20	09 90 00	Painting and Coating	sample		x								04/01/20				x		x		
6			10 21 13.17.02	03/24/20	10 21 13.17	Phenolic Toilet Compartments	sample		x								03/31/20		X						Brushed Aluminum
7			10 22 39.02.A	03/24/20	10 22 39	Folding Panel Partitions	samples		x								04/01/20		X						Grey
8			32 13 18.02.C	03/24/20	32 13 18	Cement & Concrete for Exterior Improvement	mockup		x					MIG			06/18/20				x		x		Please postpone site review until such time as Shelter in Place order is lifted. Originally returned RR 04/07/20
9			07 54 19.01.B	03/26/20	07 54 19	Polyvinyl Chloride PVC Roofing											04/09/20		x						
10			07 54 19.02.B	03/26/20	07 54 19	Polyvinyl Chloride PVC Roofing											04/09/20		x						
11			28 31 00.01.A	03/26/20	28 31 00	Voice Evacuation Fire Alarm	product data							OMM			04/09/20		X						
12			28 31 00.02	03/26/20	28 31 00	Voice Evacuation Fire Alarm	shop drawing							OMM			04/09/20				X		x		
13			32 13 18.02.D	03/26/20	32 13 18	Cement & Concrete for Exterior Improvement	mockup / product data for topcast							MIG / BKF			04/09/20				X		x		Re-opened 05/11 and returned 06/18
14			06 41 00.01.A	03/27/20	06 41 00	Architectural Wood Casework											04/17/20		X						NOTE: Arts&Crafts and Kinder Cubbies to be reviewed in separate document. Exercise room Cubbies + R18 rack NOT shown in submittal.
15			08 71 00.03.A	03/27/20	08 71 00	Door Hardware	storefront door hardware schedule							Manthey	03/30/20	04/14/20	04/15/20		X						
16			10 14 00.01.A	03/27/20	10 14 00	Signage	shop drawings			x				Squarepeg	04/07/20	08/26/20	09/03/20		x				X		See ASI-060. Resubmit for Record. N&T to provide comments on Orientation Map.
17			23 00 00.01	03/27/20	23 00 00	HVAC General Requirements	ductwork layout			x				IG	03/27/20		04/13/20				x		x		G+S to arrange coordination meeting to review submittal comments.
18			23 34 15.01.A	03/27/20	23 34 15	Ceiling Fans								IG	03/27/20	04/07/20	04/10/20		x						Awaiting IG comments on ceiling fan bracing
19			23 82 29.02.A	03/27/20	23 81 29	Variable Refrigerant Flow VRF System								IG	03/27/20		04/06/20	x							
20			07 92 00.04	03/30/20	07 92 00	Joint Sealants											04/15/20	x							

ATTACHMENT 2

NOLL & TAM ARCHITECTS

SUBMITTAL LOG - COVID

Project:		Project Number:	Last Updated:	
Los Altos Community Center		21730.00	10/15/2020	
● Pending	0	Total: 82	Resubmittal Required	1
● Returned	82			

21	●	☒	10 14 00.02	03/30/20	10 14 00	Signage	product info							Squarepeg	04/07/20	04/08/20	04/17/20	X							
22	●	☒	10 28 13.01.A	03/30/20	10 28 13	Commercial Toilet Accessories	bench in shower/changing room										04/16/20		X						
23	●	☒	23 72 33.01.A	03/30/20	23 72 33	Energy Recovery Ventilators								IG	03/27/20		04/06/20		x						
24	●	☒	26 51 01.01.D	03/30/20	26 51 01	Lighting	shop drawing for H1							OMM	03/30/20		04/07/20		X						
25	●	☒	27 05 36.01.A	03/30/20	27 05 36	Cable Trays for Comm System								SFMI		03/31/20	04/02/20		x						
26	●	☒	27 05 36.02	03/30/20	27 05 36	Cable Trays for Comm System								SFMI		03/31/20	04/02/20		x						
27	●	☒	09 51 00.01.A	03/31/20	09 51 00	Acoustical Ceilings	substitution request for vinyl ceiling tile										04/10/20	X							
28	●	☒	26 31 01.01.B	03/31/20	26 31 01	Photovoltaic System								OMM	03/31/20	04/01/20	04/02/20					x	x		
29	●	☒	26 31 01.02.B	03/31/20	26 31 01	Photovoltaic System								OMM	03/31/20	04/01/20	04/02/20					x	x		
30	●	☒	07 92 00.01.B	04/02/20	07 92 00	Joint Sealants	plumbing										04/15/20		X						
31	●	☒	25 30 00.01.A	04/02/20	25 30 00	Bldg. Automation Sensors & Control	product info							IG			04/15/20		x						
32	●	☒	25 30 00.02	04/02/20	25 30 00	Bldg. Automation Sensors & Control	shop drawing							IG			04/15/20		X						
33	●	☒	26 24 00.01.E	04/02/20	26 24 00	Service & Distribution System								OMM	04/02/20	04/17/20	04/17/20		x						
34	●	☒	08 11 16.01.A	04/03/20	08 11 16	Aluminum Doors & Frames	product data										04/03/20				x		x		coordinated with 088000.01
35	●	☒	08 51 13.01.A	04/06/20	08 51 13	Aluminum Windows	product data and shop drawings										05/05/20		x						ASI-058 window screens at 8 locations (Admin + Café) Resubmit for record - provide hardware prdoduct data
36	●	☒	23 37 13.01	04/06/20	23 37 13	Air Diffusers Registers & Grills	product data										04/21/20				X		x		
37	●	☒	26 51 01.01.E	04/06/20	26 51 01	Lighting	shop drawings for L2, L3, W2, W3, W4							OMM	04/06/20	04/24/20	04/24/20		x						
38	●	☒	09 54 26.03	04/07/20	09 54 26	Suspended Wood Ceilings	product info										04/29/20								
39	●	☒	07 42 13.16.01	04/08/20	07 42 13.16	Metal Plate Wall Panels	product information										04/22/20		x						
40	●	☒	07 42 13.16.02	04/08/20	07 42 13.16	Metal Plate Wall Panels	shop drawings										04/22/20				x		x		
41	●	☒	07 21 00.01.B	04/13/20	07 21 00	Thermal Insulation	resubmittal										04/27/20	X							
42	●	☒	09 77 23.01.A	04/13/20	09 77 23	Fabric Wrapped Panels											04/29/20								
43	●	☒	09 77 23.02.A	04/13/20	09 77 23	Fabric Wrapped Panels											04/29/20								Requested color chart for available standard colors. No custom image required for project. (CONFIRM IN ASI for CREDIT?)
44	●	☒	23 34 00.01.A	04/13/20	23 34 00	HVAC Fans								IG	04/13/20	04/21/20	04/29/20		x						
45	●	☒	26 43 00.01.A	04/13/20	26 43 00	Transient Voltage Surge Suppressor								OMM	04/13/20	04/29/20	04/29/20	x							
46	●	☒	26 43 00.02	04/13/20	26 43 00	Transient Voltage Surge Suppressor								OMM	04/13/20	04/29/20	04/29/20	x							
47	●	☒	08 11 16.02	04/15/20	08 11 16	Aluminum Doors & Frames	sample										04/27/20				x		x		Revise & Resubmit - Black is preferred color (match exterior storefront).
48	●	☒	09 54 26.01.A	04/15/20	09 54 26	Suspended Wood Ceilings											04/29/20	x							

ATTACHMENT 2

NOLL & TAM ARCHITECTS

SUBMITTAL LOG - COVID

Project: Los Altos Community Center			Project Number: 21730.00	Last Updated: 10/15/2020	
●	Pending	0	Total:	82	Resubmittal Required	1
●	Returned	82			

49	●	☒	09 54 26.03.A	04/15/20	09 54 26	Suspended Wood Ceilings											04/29/20	x							
50	●	☒	22 42 00.01.B	04/15/20	22 42 00	Plumbing Fixtures								IG	04/15/20	04/21/20	04/27/20				x		x		ProFlo products not acceptable without information on manufacturing and testing facilities
51	●	☒	26 36 01.01.B	04/15/20	26 36 01	Automatic Transfer Switch								OMM	04/15/20	04/29/20	04/29/20		x						
52	●	☒	08 80 00.02.B	04/17/20	08 80 00	Glazing	samples for GL-6 & GL-7										05/05/20		x						
53	●	☒	26 31 01.01.C	04/17/20	26 31 01	Photovoltaic System								OMM	04/17/20	05/01/20	05/05/20				x		x		
54	●	☒	26 31 01.02.C	04/17/20	26 31 01	Photovoltaic System								OMM	04/17/20	05/01/20	05/05/20				x		x		
55	●	☒	26 51 01.01.F	04/17/20	26 51 01	Lighting	P1 & P2 fixture shop drawings							OMM	04/21/20	05/11/20	05/12/20		x						
56	●	☒	33 10 00.03	04/24/20	33 10 00	Water System	shop drawings							BKF	04/24/20	05/08/20	05/08/20		x						
57	●	☒	28 31 00.01.B	04/27/20	28 31 00	Voice Evacuation Fire Alarm	product data / calcs resubmittal							OMM	04/27/20	05/12/20	05/14/20	x							
58	●	☒	28 31 00.02.A	04/27/20	28 31 00	Voice Evacuation Fire Alarm	shop drawing resubmittal							OMM	04/27/20	05/12/20	05/14/20	x							
59	●	☒	07 42 13.16.03	05/04/20	07 42 13.16	Metal Plate Wall Panels	sample - 2 coat		x								05/19/20								
60	●	☒	08 11 16.02.A	05/04/20	08 11 16	Aluminum Doors & Frames	sample		x								05/19/20		x						Anodized Dark Bronze
61	●	☒	10 22 39.02.B	05/04/20	10 22 39	Folding Panel Partitions	sample										05/20/20								RAL 9011 (Graphite Black)
62	●	☒	26 51 01.02.B	05/04/20	26 51 01	Lighting	additional samples		x								05/19/20		x						brushed aluminum
63	●	☒	12 24 00.02.A	05/05/20	12 24 00	Window Shades	product data resubmittal	x									05/22/20		X						
64	●	☒	12 24 00.03.A	05/05/20	12 24 00	Window Shades	shop drawing resubmittal			x							05/19/20				x		x		
65	●	☒	12 24 00.05.A	05/05/20	12 24 00	Window Shades	leed resubmittal					x					05/19/20	x							
66	●	☒	22 42 00.01.C	05/05/20	22 42 00	Plumbing Fixtures	product data							IG	05/06/20	05/15/20	05/19/20				x		x		all items acceptable, with request for one correction
67	●	☒	07 42 09.02.A	05/06/20	07 42 09	Exterior Acoustic Roof Screen	shop drawings										05/22/20		X						
68	●	☒	27 11 16.01.A	05/06/20	27 11 16	Comm Cabinets, Racks & Frames								SFMI	05/06/20	05/06/20	05/20/20				X		x		
69	●	☒	27 11 19.01.A	05/06/20	27 11 19	Comm Termination Blocks & Patch								SFMI	05/06/20	05/07/20	05/20/20		X						
70	●	☒	27 13 00.01.A	05/06/20	27 13 00	Comm Indoor Backbone Cabling								SFMI	05/06/20	05/06/20	05/20/20				x		x		contractor to provide CMP rated cable
71	●	☒	27 15 00.01.A	05/06/20	27 15 00	Comm Horizontal Cabling								SFMI	05/06/20	05/06/20	05/20/20				x		x		
72	●	☒	09 77 23.01.B	05/07/20	09 77 23	Fabric Wrapped Panels	test reports										05/22/20	x							
73	●	☒	09 77 23.02.B	05/07/20	09 77 23	Fabric Wrapped Panels	color samples										05/20/20				x		x		
74	●	☒	09 54 26.02.A	05/08/20	09 54 26	Suspended Wood Ceilings	shop drawing resubmittal			x							05/26/20				x		x		
75	●	☒	09 77 23.03	05/08/20	09 77 23	Fabric Wrapped Panels	shop drawings			x							05/21/20				x		x		no details or dimensions, scope documents only
76	●	☒	32 80 00.01	05/08/20	32 80 00	Landscape Irrigation								MIG	05/08/20	05/21/20	05/21/20				X		x		
77	●	☒	07 42 13.16.03.A	05/14/20	07 42 13.16	Metal Plate Wall Panels	sample - 3 coat		x								05/19/20								TOB black equivalent (3 coat)
78	●	☒	12 24 00.01.A	05/14/20	12 24 00	Window Shades	sample										05/26/20		x						
79	●	☒	27 11 23.01.A	05/14/20	27 11 23	Comm Cable Management								SFMI	05/14/20	05/14/20	05/20/20	x							

NOLL & TAM ARCHITECTS

SUBMITTAL LOG - COVID

Project: Los Altos Community Center		**Project Number:** **21730.00**	**Last Updated:** 10/15/2020	
● Pending	0	Total:	82	Resubmittal Required: 1
● Returned	82			

80	●	☒	**07 62 00.04**	**05/15/20**	**07 62 00**	**Sheet Metal Flashing & Trim**								WJE	05/23/20	05/27/20	**05/29/20**				x		x		
81	●	☒	**07 42 53.01.B**	**05/18/20**	**07 42 53**	**Fiber Cement Rainscreen Panels**	**calculations**							DSE	05/21/20	05/28/20	**05/29/20**				x		x		fasteners and attachment calcs not complete
82	●	☒	**07 62 00.05**	**05/18/20**	**07 62 00**	**Sheet Metal Flashing & Trim**	**sample - Matte Black**		x								**05/27/20**		x						

ATTACHMENT 2

NOLL & TAM
ARCHITECTS

MODIFICATION LOG-COVID

Project: Los Altos Community Center | **Project 21730** | **Last Updated:**

Noll and Tam

Modification Type

Status	RFP #	CCD #	Date Received	Date Issued to Contractor	ASI #	Revision	ASI Title	RFI Reference	Submittal Reference	Drawing / Sheet Title	Discipline+M8:M20MM8:M18	Document Type	Sketch Number	Sheets Issued	Drawing Reference	Additional Description
☒				**03/24/20**	039	1	Revise ASI 39 - FEC locations			G1.02, A7.11, A7.17, a7.18						
☒				**03/24/20**	046		Meeting Room Cement Fiber Panel and Sill				Arch/Struct		A6.67: SSK31			**Adjust window sill above meeting room roof; dimension point at top of cement fiber panels, simplify metal trim work**
☒				**03/24/20**	049		Door 156.1 Details				Arch		A6.52			**Add door sill detail, coordinate frame with Jamb and Head details**
☒				**03/24/20**	052		Eliminate VGA									
☒				**03/25/20**	045		Low Voltage Lighting Zone				Arch,, Elec		E2.02			**OMM to issue**
☒				**03/25/20**	053		Framing Clarifications		92400		Structu		ssk30			**Followup to 3/13/20 Field Observation Report**
☒				**03/27/20**	050		WC Revisions				P		P0.02,, P4.01, P4.02			**Toilet at Kinder RR1 -revise toilet spec in Kinder RR 165A**
☒				**03/31/20**	034	R1	Shower Floor					ASK	20.R1			Revised to renumber tile to CT5 (avoids duplicate numbering)
☒				**03/31/20**	051		Misc. Restroom Revisions				Arch			A4.21, A4.22, A4.23		**Eliminate cove base at wall, coordinate schluter**
☒				**03/31/20**	055		Wood Wall Panels	RFI 91		Added details 9 & 10 on A8.72	Arch			A8.72		**extend decorative wall up to bottom of deck. Acoustic wood veneer panels extend past bottom of**
☒				**04/03/20**	054		ATT Box				Civil/Low Voltage			CC2.1, 3.1 C4.1, TN1.0		**Sent to Nova -4/3 Nova holding for issuance**
☐				**04/21/20**	056		Storefront and Framing Clarifications									
☒				**05/05/20**	058		Window Screens				Arch	ASK	ASK-030			
☒				**05/11/20**	059		MEP coordination				Mech, Arch	ASK, Sheet	ASK-031	A2.41, A7.12, A7.14, M0.03, M2.01, M4.01, [illegible]		

NOLL & TAM ARCHITECTS

RFI LOG-COVID

Project: Los Altos Community Center	Project Number:	21730	Last Updated:	

Covid Index	RFI #	Initiated At	Assigned	Due Date	Subject	Status	Responsible Contractor	Drawing Number	Reference	Closed Date
1	82	3/9/2020	Gwise, James (Noll & Tam Architects)	3/16/2020	Pendent sprinkler finish in exposed areas	Closed	RCM Fire Protection, Inc.	A2.41		3/10/2020
2	83	3/12/2020	Kawamoto, Mae (Daedalus Structural Engineering); Gwise, James (Noll & Tam Architects)	3/18/2020	fall restraint anchoring and spacing	Closed	Gonsalves & Stronck Construction Company Inc.	3/S7.04, A2.33		3/16/2020
3	90	3/13/2020	Hartman, Theo (Smith Fause & McDonald, Inc.); Gwise, James (Noll & Tam Architects)	3/20/2020	Raceway and backbox for CCAM in conference room 105	Closed	Elco Electric, Inc.	TA2.1, TA7.6		4/13/2020
4	89	3/13/2020	Hartman, Theo (Smith Fause & McDonald, Inc.); Gwise, James (Noll & Tam Architects)	3/20/2020	Boundary microphone location in conference room 105	Closed	Elco Electric, Inc.	TA2.1		4/13/2020
5	88	3/13/2020	Hartman, Theo (Smith Fause & McDonald, Inc.); Gwise, James (Noll & Tam Architects)	3/20/2020	AV and PA trim device colors	Closed	Elco Electric, Inc.	TA2.1, TA6.1		3/19/2020
6	87	3/13/2020	Hartman, Theo (Smith Fause & McDonald, Inc.); Gwise, James (Noll & Tam Architects)	3/20/2020	Exercise room 190 AV equipment	Closed	Elco Electric, Inc.	TA2.1, TA7.4		3/19/2020
7	86	3/13/2020	Gwise, James (Noll & Tam Architects); Hartman, Theo (Smith Fause & McDonald, Inc.)	3/20/2020	wireless microphone antennas	Closed	Elco Electric, Inc.	TA6.1, TA7.2, TA7.3, TA7.4, TA7.5, TA7.6		4/1/2020
8	85	3/13/2020	Hartman, Theo (Smith Fause & McDonald, Inc.); Gwise, James (Noll & Tam Architects)	3/20/2020	Rack in teen room 180	Closed		TA2.1		3/19/2020
9	84	3/13/2020	Gwise, James (Noll & Tam Architects); Carey, Paul (O'Mahony & Myer Electrical)	3/20/2020	exterior light fixture mounting heights-confirmation	Closed	Elco Electric, Inc.	E2.01		3/26/2020
10	91	3/23/2020	Gwise, James (Noll & Tam Architects)	3/26/2020	community room acoustic wood veneer panel termination	Closed	Gonsalves & Stronck Construction Company Inc.	A7.18		4/1/2020
11	92	3/25/2020	Gwise, James (Noll & Tam Architects); Carey, Paul (O'Mahony & Myer Electrical)	4/1/2020	exterior emergency fixtures clarification	Closed		E1.02, E2.01, E6.03		4/6/2020
12	93	3/26/2020	Gwise, James (Noll & Tam Architects)	3/30/2020	recessed waste disposal/paper towel dispenser height	Closed	Gonsalves & Stronck Construction Company Inc.	G3.21		4/1/2020
13	95	3/27/2020	Gwise, James (Noll & Tam Architects); Colbert, Matt (Integral Group)	4/3/2020	thermostat type in kitchen served by AHU-4	Closed	Axis Mechanical, Inc.	M2.01		4/6/2020

NOLL & TAM ARCHITECTS

RFI LOG-COVID

Project: Los Altos Community Center	Project Number:	21730	Last Updated:	

Covid Index	RFI #	Initiated At	Assigned	Due Date	Subject	Status	Responsible Contractor	Drawing Number	Reference	Closed Date
14	94	3/27/2020	Gwise, James (Noll & Tam Architects); Colbert, Matt (Integral Group); Hernandez, Alena (Ciari Plumbing & Heating)	4/3/2020	EF4-EF7 mounting locations and duct routing clarification	Closed	Axis Mechanical, Inc.	M2.01		6/3/2020
15	96	4/13/2020	Gwise, James (Noll & Tam Architects); Kawamoto, Mae (Daedalus Structural Engineering)	4/20/2020	notching top of 3 1/2" x 9 1/2" PSL's for duct clearance (1/A8.45)- confirmation	Closed	Gonsalves & Stronck Construction Company Inc.	1/A8.45, M2.01, A2.41		4/21/2020
16	101	4/20/2020	Gwise, James (Noll & Tam Architects)	4/27/2020	exterior finish above clerestory window 31- clarification	Closed	Gonsalves & Stronck Construction Company Inc.	10/A3.11, 9/A6.65, 16/A6.4		5/1/2020
17	100	4/20/2020	Gwise, James (Noll & Tam Architects)	4/27/2020	storefront 07 exterior finish above head	Closed	Gonsalves & Stronck Construction Company Inc.	A6.61, 16/A6.64, 5/A3.12		4/29/2020
18	99	4/20/2020	Gwise, James (Noll & Tam Architects)	4/24/2020	eave trim at vent screen- dimensional clarification	Closed	Gonsalves & Stronck Construction Company Inc.	A6.21, A6.22, A6.23		4/21/2020
19	98	4/20/2020	Gwise, James (Noll & Tam Architects)	4/24/2020	trim at jamb and head condition -storefront 43 at community room	Closed	Gonsalves & Stronck Construction Company Inc.	2/A3.22, 14/A6.51, 17/A6.51, A2.31		4/29/2020
20	97	4/20/2020	Gwise, James (Noll & Tam Architects)	4/24/2020	FCP to cedar siding transition clarification	Closed		2/A3.32, 14/A6.22		4/29/2020
21	102	4/22/2020	Gwise, James (Noll & Tam Architects)	4/27/2020	sliding door 190.2 trim profile confirmation	Closed	Gonsalves & Stronck Construction Company Inc.	12/A6.41, 13/A6.51		4/29/2020
22	103	4/24/2020	Gwise, James (Noll & Tam Architects); Colbert, Matt (Integral Group)	4/30/2020	Big Ass Fan mounting height/ extension tube clarification	Closed	Axis Mechanical, Inc.	A2.41		5/1/2020
23	105	5/5/2020	Gwise, James (Noll & Tam Architects); Kawamoto, Mae (Daedalus Structural Engineering)	5/12/2020	roof plane D-E/ DD-BB	Closed	Gonsalves & Stronck Construction Company Inc.	A2.33, A3.11, 7/A5.11, 2/A6.31, S1.02, 2/S7.01		5/15/2020
24	104	5/5/2020	Gwise, James (Noll & Tam Architects)	5/8/2020	jamb trim thickness clarification- ext. door detail 13,17/A6.51	Closed		13, 17/A6.51		5/5/2020

NOLL & TAM ARCHITECTS

RFI LOG-COVID

Project: Los Altos Community Center	Project Number:	21730	Last Updated:	

Covid Index	RFI #	Initiated At	Assigned	Due Date	Subject	Status	Responsible Contractor	Drawing Number	Reference	Closed Date
25	106	5/6/2020	Kawamoto, Mae (Daedalus Structural Engineering); Gwise, James (Noll & Tam Architects)	5/8/2020	L angle support at rake-connection detail clarification	Closed	Gonsalves & Stronck Construction Company Inc.	2/A6.32, 17/S6.04		5/11/2020
26	107	5/7/2020	Gwise, James (Noll & Tam Architects)	5/11/2020	library connector pergola post size	Closed	Gonsalves & Stronck Construction Company Inc.	A6.01		5/11/2020
27	112	5/8/2020	Gwise, James (Noll & Tam Architects)	5/15/2020	solid wood baseboard clarification	Closed	Gonsalves & Stronck Construction Company Inc.	A9.13, 7.11, 7.12, 7.15		5/11/2020
28	111	5/8/2020	Gwise, James (Noll & Tam Architects)	5/11/2020	cedar siding mill profile	Closed	Gonsalves & Stronck Construction Company Inc.	12/A6.22		5/19/2020
29	110	5/8/2020	Gwise, James (Noll & Tam Architects)	5/12/2020	dog house dimensions and layout	Closed	Gonsalves & Stronck Construction Company Inc.	AA2.33, A5.11		5/11/2020
30	109	5/8/2020	Colbert, Matt (Integral Group); Kawamoto, Mae (Daedalus Structural Engineering); Gwise, James (Noll & Tam Architects)	5/13/2020	roof top condenser unit mounting (ACC-3)	Closed	Gonsalves & Stronck Construction Company Inc.	S1.03, S1.06. M2.02		5/15/2020
31	108	5/8/2020	Gwise, James (Noll & Tam Architects)	5/13/2020	MP-1 baseboard clarification	Closed	Gonsalves & Stronck Construction Company Inc.	A7.13, A9.13		5/11/2020
32	113	5/13/2020	Kawamoto, Mae (Daedalus Structural Engineering); Gwise, James (Noll & Tam Architects)	5/15/2020	interpretation of center bottom chord truss rod threading	Closed	Delta Steel Construction	S7.02		5/19/2020
33	114	5/15/2020	Gwise, James (Noll & Tam Architects)	5/19/2020	ceiling height-storage 165C	Closed	Gonsalves & Stronck Construction Company Inc.	A2.31, A2.41, 9/A3.23		5/20/2020
34	115	5/20/2020	Gwise, James (Noll & Tam Architects); Colbert, Matt (Integral Group)	5/26/2020	ERV-1 layout	Closed	Axis Mechanical, Inc.	A4.40, M2.01		6/2/2020
35	116	5/27/2020	Colbert, Matt (Integral Group); Gwise, James (Noll & Tam Architects)	5/29/2020	Firesprinkler branch line offset- room 160	Closed	RCM Fire Protection, Inc.			5/27/2020

DISCUSSION ITEM

Agenda Item # 11

AGENDA REPORT SUMMARY

Meeting Date: October 27, 2020

Subject: City Council Finance Subcommittee Proposal

Prepared by: Chris Jordan, City Manager

Attachment(s):

1. September 24, 2019 City Council Meeting Minutes
2. Adopted Capital Improvement Plan – June 2020

Initiated by:
City Council

Previous Council Consideration:

Fiscal Impact:
- Unknown

Environmental Review:
N/A

Policy Question(s) for Council Consideration:
- Does the City Council wish to form a City Council Finance Subcommittee?

Summary:
- At its October 13 meeting, as part of the discussion on the Emergency Operations Center and the Financial Update, members of the City Council asked questions that staff was not provided the opportunity to respond too or were not on the agenda
- A member of the Council then requested the formation of a Finance Subcommittee and the Council placed this on the October 27 agenda

Recommended Motion:
There is no recommended motion

Reviewed By:

City Manager	City Attorney	Finance Director
CJ	JH	SE

Subject: City Council Finance Subcommittee Proposal

Purpose

The City Council wants to discuss the formation of Council Finance subcommittee.

Background

During the October 13 Study Session regarding financial status, Administrative Services Director Sharif Etman informed the Council that although the audit is not yet complete, it is confident that it will show that the City finished FY 2020 (June 30, 2020) with approximately $900,000 more in resources that anticipated during the June budget discussions. This is especially good news given that some members of the Council and the public believed staff was being too optimistic in our projects. On the contrary, it now appears that staff was appropriately prudent in our assumptions. Staff also explained that it is still too early in FY 2021 for firm revenue estimates, but we believe that overall revenues should be tracking close to the June estimates.

Issues raised by the Council during the Study Session included:

- *Lack of a Financial Forecast.* Financial forecasts are typically two times each year: when the budget is proposed and after the completion of the audit. Due to the variability of revenues during the pandemic as well as the lack of predictability around the cost of ongoing litigation, staff presented a Two-year financial forecast (at the recommendation of the financial commission) to the Council on June 9 as part of the discussions about amendments to the adopted Biennial Budget. Staff will update this forecast to reflect audited actuals for FY 2020 when presenting the any mid-year Budget adjustments early in 2021.

- *Council needs to take a deep dive in the Budget.* Staff is always willing to share all the City's financial information with the Council. (The public is also welcome to review these documents, except for those records exempt from disclosure such as ongoing litigation costs.) In fact, as part of the June 2020 Budget discussions, staff provided the Council and public with line-item detail of all the City's operating expenses. This information is as granular as any available and included over 20 pages of spreadsheets. In addition, staff has been working since last Spring (when the City's new Financial Enterprise Resource Program was fully installed and operational) to install a real-time financial dashboard on the City's website which will provide up-to-date information on the City's financial status.

- *Community Center financial status.* The Council-approved budget for the new community center is $38.3 million. On the City's website are monthly reports on the progress of the community center that include detailed information about the budget and schedule status of the project. It also includes a list of all approved change orders. As was discussed during the Study Session, the current commitment on the City's part for $35.2 million. However, largely due to the pandemic, staff fully expects that this total will soon increase to approximately $37 million. It should also be noted that most large change orders or amendments typically occur early in the project as unforeseeable issues usually arise during demolition of existing structures or during excavation for the new project. This project is slightly different due to the pandemic, but, unless here are other und=foreseeable events (weather, natural disaster, pandemic, etc.) staff believes the project should be completed within the $38.3 million budget. Monthly reports (September 2019-September 2020) can be found at:

https://www.losaltosca.gov/publicworks/page/los-altos-community-center

The Council raised other budget questions when discussing the Emergency Operations Center. It is important to note that the Emergency Operations Center agenda item was a noticed, quasi-judicial public hearing to determine if the designed EOC complied with the City's zoning code, as recommended by the Planning Commission. It was not intended to be a discussion of the merits of an EOC or the budget for the EOC – those are different topics that are not related to a design review public hearing and would have required a separate agenda item.

As part of the discussion, the Council did raise certain questions that can be addressed at this time as the Council discusses the possible formation of a Finance Subcommittee.

- *What are the Facility Priorities?* As staff responded, the priorities that staff is pursuing are those determined by the Council at its September 24, 2019 meeting (Minutes attached). All members of the Council voted 1-5 for their top facility priorities. (The Emergency Operations Center was not included as Council had previously determined that it was the top priority, and the project was already being designed.) The top 5 in order were:

1. Police Station renovations
2. Annual Pavement Improvements
3. Grant Park Community Center
4. Los Altos Youth Center
5. Parks Renovations

- *Where is the money for the EOC coming from*? Attached is the adopted Capital Improvement Plan. The CIP was adopted by the Council on June 23, 2020. The Council will recall that staff recommended pausing the EOC project for 6-12 months until we had a better understanding of the short and long-term financial impacts of the pandemic, and to be able to continue to put adequate funding toward street maintenance. However, the Council wanted to move forward with the EOC project and moved funding from various projects to be able to keep the project moving forward. These funds included reallocating $500,000 from the Technology Reserve to the CIP Fund to provide adequate funding to keep this project moving forward. However, as was discussed with the Council during the meeting, adequate funding to complete the project are not available in the FY 2021 Budget and more will be needed. This was noted in the Council Report for the June 23 meeting:

  Emergency Operations Center (this will require an additional allocation of funds for FY22 as there is not enough funds available in FY21 to complete the project.)

- *The Council does not know what the trade-offs were to fund the EOC.* As discussed during the June Budget sessions, the Council reallocated funds from certain projects to move forward with the EOC. Attached is the final CIP the Council adopted on June 23 and was provided to the Council as an attachment to July 14 agenda.

Should the City Council wish to appoint a Finance Subcommittee, the Financial Commission may wish to have input into the scope of such a subcommittee. The schedule for the subcommittee should also be discussed as staff is currently working with the team of auditors to ensure completion of the Comprehensive Annual Financial Report in a timely fashion and because the Finance staff is currently understaffed – the Senior Accountant position has been left vacant as part of the operational reductions included in the adopted FY 21 Budget.

Recommendation

This is a Council decision and there is no staff recommendation.

ADOPTED MINUTES OF THE REGULAR MEETING OF THE CITY COUNCIL OF THE CITY OF LOS ALTOS, HELD ON TUESDAY, SEPTEMBER 24, 2019, BEGINNING AT 7:00 P.M. AT LOS ALTOS YOUTH CENTER, 1 NORTH SAN ANTONIO ROAD, LOS ALTOS, CALIFORNIA

ESTABLISH QUORUM
All members present

PLEDGE OF ALLEGIANCE
Members of Girl Scout Cadette Troop 60402 presented the colors and led the Flag Salute.

CLOSED SESSION ANNOUNCEMENT
Mayor Lee Eng reported the following:

1. Public Employment - Title: City Attorney
Pursuant to Government Code Section 54957

Action: The City Council directed Council Members Bruins and Fligor to initiate an exploration process for a City Attorney. The third term of the current City Attorney's contract expires in April 2020. Therefore, the Council would like to explore the options for legal representation in the market to ensure that the interests of the City and residents continue to be well represented.

2. Conference with Legal Counsel – Existing Litigation
Pursuant to Government Code Section 54956.9(d)(1)
Name of Case: *California Renters Legal Advocacy and Education Fund, San Francisco Bay Area Renters Federation, Victoria Fierce, and Sonja Trauss v. City of Los Altos, et al.*
Santa Clara County Superior Court, Case No. 19CV350422
No action taken

3. Conference with Legal Counsel – Existing Litigation
Pursuant to Government Code Section 54956.9(d)(1)
Name of Case: *40 Main Street Offices LLC v. City of Los Altos, et al.*
Santa Clara County Superior Court, Case No. 19CV349845

No action taken

4. Conference with Legal Counsel – Existing Litigation
Pursuant to Government Code Section 54956.9(d)(1)
Name of Case: *GoldSilverIsland Homes, LLC v. City of Los Altos, et. al.*
Santa Clara County Superior Court, Case No. 19CV352667

No action taken

CHANGES TO THE ORDER OF THE AGENDA

Action: Upon motion by Council member Bruins, seconded by Councilmember Enander, the Council unanimously reordered the agenda, taking item 5 after item 2 and before item 3.

SPECIAL PRESENTATION

Mayoral Proclamation recognizing Compassion Week

Action: The Council received an overview on Compassion Week activities. Mayor Lee Eng presented a proclamation to Compassion Week volunteers: Jan McDaniel and Steve Tani, Compassion Week Co-chairs; Joe Eyre and Nadja Jackson, Los Altos Community Foundation, and Dave Beggs, Compassion Week Leadership Team.

SPECIAL ITEM

PUBLIC COMMENTS ON ITEMS NOT ON THE AGENDA
Members of the audience may bring to the Council's attention any item that is not on the agenda. Please complete a "Request to Speak" form and submit it to the City Clerk. Speakers are generally given two or three minutes, at the discretion of the Mayor. Please be advised that, by law, the City Council is unable to discuss or take action on issues presented during the Public Comment Period. According to State Law (also known as "the Brown Act") items must first be noticed on the agenda before any discussion or action.

The Council heard comments from the following persons:

Ashok Vashee	Gail Ostendorf	Jan Thomas
Penny Lave	Gary Hedden	King Lear
Jane Reed	Curtis Cole	David Reeder
Debbie Skelton	Sandy Salinger	Paula Stanek

CONSENT CALENDAR
These items will be considered by one motion unless any member of the Council or audience wishes to remove an item for discussion. Any item removed from the Consent Calendar for discussion will be handled at the discretion of the Mayor.

1. Council Minutes: Approve the minutes of the September 10, 2019 study session and September 10, 2019 regular meeting (D. Hawkins)

   Action: Council Members Bruins and Enander made additional revisions to the draft minutes submitted. Upon Motion by Council Member Bruins, seconded by Council Member Enander, the Council unanimously approved the minutes as revised.

DISCUSSION ITEMS

2. 4350 El Camino Story Pole Exception: Adopt Resolution No. 2019-41 to approve or deny an exception from the City's Story Pole Policy for the proposed development at 5150 El Camino Real (J.Biggs)

Staff presented their report and the Council heard testimony from the applicant and the architect. Councilmembers discussed the item with the applicant, the applicant's architect, interested community members, and staff. .

Public Comment: Eric Steinle

Action: Upon motion Councilmember Fligor, seconded by Councilmember Bruins, the Council unanimously continued the item to a future date to be scheduled approximately two months prior to the development application being filed. The Council directed the applicant to work with staff and to return to the Council with options for the installation of story poles or other alternatives on the project site to give the community an opportunity to view the project impact on the neighboring properties.

5. City Council 2019 Strategic Priorities Status Report: The Council should receive status report and provide direction to the City Manager, as necessary. (C. Jordan)

City Manager Jordan presented the staff report and Council discussion followed. Council members requested that the document include more action verbs, timelines, target dates, milestones, more detailed information regarding specific items, outcomes, etc. Council members asked for additional information regarding specific topics such as complete streets program including traffic safety and safe routes to school; Downtown Visioning including outdoor dining; zoning code objective criteria, CT zone, community engagement and upcoming meetings;

Public Comment: Heather Larkin, Teresa Morris

3. Capital Improvement Plan Prioritization: The Council will receive information regarding the Capital Improvement Plan, prioritize projects, and provide direction to the City Manager, as necessary. (J.Sandoval/S.Etman)

Council Members asked questions of staff regarding specific projects and discussed the prioritization exercise.

Public Comment: Roberta Phillips

Action: The Council participated in a prioritization exercise by written ballot. Each Councilmember was asked to assign a priority 1 – 5 (1 being highest and worth 5 points; 5 being the lowest and worth 1 point). Ballots were gathered and tabulated with the following results:

1. Police Department Renovation
2. Annual Pavement Improvement
3. Grant Park Community Center
4. Los Altos Youth Center
5. Parks Renovation

The following chart contains the votes and priorities of each Council Member:

Project	Mayor Lee Eng		Vice Mayor Pepper		CM Bruins		CM Enander		CM Fligor		Sum	Priority Ranking
	Priority	Points	Priority	Points	Priority	Points	Priority	Points	Priority	Points		
Annual Pavement Improvements	3	3	3	3			1	5	1	5	16	**2**
Los Altos Youth Center		0	2	4	2	4		0		0	8	**4**
City Hall Renovation		0	4	2	3	3		0		0	5	
Police Department Renovations	1	5	1	5	1	5	2	4	2	4	23	**1**
Parks Renovation	4	2		0	5	1	4	2	5	1	6	**5**
Grant Park Community Center	2	4		0	4	2	3	3	3	3	12	**3**
Halsey House redevelopment		0		0		0		0		0	0	
Garden House renovations		0		0		0		0	4	3	3	
Public Pool Study		0	5	1		0		0		0	1	

4. Ordinance No. 2019-463; Amending Section 10.12.137 of the Los Altos Municipal Code. Introduce and waive further reading of Ordinance No. 2019-463: Amending Section 10.12.137 of the Los Altos Municipal Code regarding Billing of Master Metered Condominium Units with Water Sub-Meters (J. Sandoval)

Action: Upon motion by Vice Mayor Pepper, seconded by Councilmember Bruins, the Council unanimously adopted the first reading of Ordinance 2019-463 and requested follow-up information on the notification of the change to property owners, home owners' associations, and/or residents.

5. City Council 2019 Strategic Priorities Status Report: The Council should receive status report and provide direction to the City Manager, as necessary. (C. Jordan)

Item taken out of order. Please see above.

6. Discuss and review Council Norms process on adding items to the Agenda. (Lee Eng/Enander).

Action: The Council continued the item and directed Mayor Lee Eng and Councilmember Enander to return to the Council with an updated, redlined draft of their suggested changes to the Council Norms, section 10.10, specifically dealing with the process of members adding items to the agenda.

7. Summary of Coalitions Addressing Telecommunications Issues at the Federal Level Impacting Wireless Deployment and Local Government Authority: Authorize the City Manager to commit the City to participation in one or more coalitions organized by Best Best & Krieger LLP, in furtherance of the Council's goal of preserving its authority to manage wireless infrastructure deployment in the City (City Staff)

The Council continued this item to a future agenda.

8. Federal and State Legislative matters: Discuss potential future federal or state legislation and provide direction as appropriate

Council member Enander reported on the status of several bills pending the Governor's signature in Sacramento. She encouraged Council members who are interested in the approval of AB 330 to communicate with the Governor's office to encourage his signing the bill. She also reported that SB 5 has been signed.

COUNCIL/STAFF REPORTS AND DIRECTIONS ON FUTURE AGENDA ITEMS

City Manager Jordan updated the Council on the status of the recruitment and hiring to fill several key staff vacancies. He reported that he will miss the October 22 Council meeting due to attendance at the ICMA conference, which Council members expressed their concurrence with his travel.

Council member Fligor reported on her attendance at various board and commission meetings and requested the City send an apology to the intended recipients of an award which was not presented and will be rescheduled

Council member Bruins reported on her attendance at various meetings and her continuing work with the VTA governance group and other topics including the ABAG 2050 process. She reported on her recent Office Hours event and requested that staff confirm with the host business or meeting site regarding the event to ensure it is on the facility's schedule.

Council member Enander reported on her attendance at a Cupertino Town Hall regarding the Lehigh plant and the Santa Clara County Board of Supervisors study session regarding the Stanford

GUP. She encouraged the Council to send a letter to the Board, similar to that which was sent to the Planning Commission prior to the Board's two public hearings on the matter. She also requested that staff, if not already doing so, to keep a record of Community Center expenditures for future PRA requests.

Vice Mayor Pepper reported on a meeting with the City Manager and Los Altos Hills Council member and City Manager regarding the NCLA activities and JPA cost sharing, with changes being taken to the Board in October.

Mayor Lee Eng requested that the CT zoning and objective zoning criteria be scheduled for a future Council agenda. She also requested that an agenda item be scheduled regarding the ADA process for discussion among Council members and the Council's responsibilities in implementing necessary accommodations. Council member Enander concurred with these requests.

ADJOURNMENT
Mayor Lee Eng adjourned the meeting at 11:40 p.m.

Lynette Lee Eng, MAYOR

Dennis Hawkins, CMC, CITY CLERK

Proposed Capital Improvement Program Budget Changes (Revised 7/3/2020)

Project #	Project Name	Funding Sources	Prior Years Available Funds	Original 2019/20 Budget	Adopted 2019/20 Revised Budget	Adopted 2019/20 Deferred Budget	Original 2020/21 Budget	Adopted 2020/21 Revised Budget	Adopted 2020/21 Deferred Budget	2021/22 Budget	2022/23 Budget	2023/24 Budget	NOTES
Civic Facilities													
CF-01003	Annual Civic Facilities Improvement	CIP		$ 1,200,000	$ 750,000		$ 1,200,000	$ 1,200,000		######	$1,200,000	$1,200,000	available for the Emergency Operations Center construction in 2019/20. The $1.2M budgeted in 2020/21 are also available for the EOC. Current construction cost estimate is $2.5M. Either $550K needs to be transferred into the
CF-01010	Annual ADA Improvements (Facilities)	CIP		$ 75,000	$ 75,000		$ 75,000	$ 75,000		$ 75,000	$ 75,000	$ 75,000	
CF-01018	MSC Parking Lot Resurfacing	CIP	$ 300,000			$ 300,000							ENGINEER'S ESTIMATE = $880K
CF-01020	Feasibility Study Swimming Pool	CIP		$ 100,000		$ 100,000							
Community Development													
CD-01018	Downtown Lighting Cabinet Replacement	CIP		$ 87,000	$ -	$ 87,000	$ -						
CD-01003	Annual Public Arts Projects	CIP		$ 10,000		$ 10,000	$ 10,000		$ 10,000	$ 10,000	$ 10,000	$ 10,000	
CD-01012	Annual Storm Drain Improvements	CIP	$ 180,000	$ 300,000		$ 480,000	$ 300,000	$ 5,000	$ 295,000	$ 300,000	$ 300,000	$ 300,000	
Transportation													
TS-01001	Annual Street Resurfacing	CIP		$ 250,000	$ 250,000		$ 250,000	$ 250,000		######	$1,250,000	$1,250,000	PCI study recommends investing $1.5M more in street resurfacing and slurrying to meet 75 by 2026. Recommend investing that in
		Gas Tax		$ 350,000	$ 350,000		$ 350,000	$ 350,000		$ 350,000	$ 350,000	$ 350,000	
		Road Maint. & Acct Act		$ 500,000	$ 500,000		$ 500,000	$ 500,000		$ 500,000	$ 500,000	$ 500,000	
		Measure B		$ 550,000	$ 550,000		$ 550,000	$ 550,000		$ 550,000	$ 550,000	$ 550,000	
		VRF			$ -			$ -					
TS-01003	Annual Street Striping	Gas Tax		$ 100,000	$ 100,000		$ 100,000	$ 100,000		$ 100,000	$ 100,000	$ 100,000	
		CIP			$ -			$ -					
TS-01004	Annual Street Slurry Seal	Gas Tax		$ 250,000	$ 250,000		$ 250,000	$ 250,000		$ 250,000	$ 250,000	$ 250,000	
		CIP			$ -			$ -		$ 500,000	$ 500,000	$ 500,000	PCI study recommends investing $1.5M more in street resurfacing and slurrying to meet 75 by 2026. Recommend investing that in
TS-01008	Annual ADA Improvements (Streets and Roadways)	CIP		$ 75,000		$ 75,000	$ 75,000		$ 75,000	$ 75,000	$ 75,000	$ 75,000	*Recommend using Traffic Impact Fees.*
		Traffic Impact Fees			*$ 75,000*		*$ -*	*$ 75,000*					
TS-01009	Annual City Alley Resurfacing	Gas Tax		$ 50,000	$ 50,000		$ 50,000	$ 50,000		$ 50,000	$ 50,000	$ 50,000	
	Fremont Asphalt Concrete Ove	OBAG	$ 336,000		$ -			$ 336,000					

TS-01056	Fremont Asphalt Concrete Ove rlay	CIP		$ -				$ 1,750,000					Finish design. Need $2M for construction. Use PCI additional recommended funding
TS-01059	Diamond Court Reconstruction	CIP		$ 100,000		$ 100,000							Staff needs to confirm if Diamond Court residents have contributed the $100,000. If so, then $100K should be relocated
		Resident Contribution		$ 100,000									
TS-01005	Annual Concrete Repair	CIP		$ 200,000	$ -	$ 200,000	$ 200,000	$ 200,000		$ 200,000	$ 200,000	$ 200,000	
TS-01006	Annual Traffic Sign Replacement	CIP		$ 25,000	$ 25,000		$ 25,000	$ 75,000		$ 25,000	$ 25,000	$ 25,000	Need additional $50K in 20/21 for sign survey and updates.
TS-01007	Annual Neighborhood Traffic Management	CIP											No active project. This fund was going to be used to help fund the Arboleda Dr portion of the Cuesta Dr Traffic Calming
		Traffic Impact Fees		*$ 50,000*		*$ 50,000*	*$ 50,000*		*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	
		Donations	$ -										
TS-01013	Annual Transportation Enhancements	CIP		$ 75,000		$ 75,000	$ 75,000		$ 75,000	$ 75,000	$ 75,000	$ 75,000	No active projects, but requesting additional $175K to offset any existing studies. Recommend using Traffic Impact Fees.
		Traffic Impact Fees		*$ -*	*$ 75,000*			*$ 250,000*					
TS-01022	Annual Collector Street Traffic Calming	*Traffic Impact Fees*	*$ 550,000*	*$ 50,000*	*$ 600,000*		*$ 50,000*	*$ 50,000*		*$ 50,000*	*$ 50,000*	*$ 50,000*	Contract award July 2020
TS-01037	San Antonio Road/West Portola Avenue Improvements (School Route Project)	*Traffic Impact Fees*		*$ -*				*$ 125,000*					Can complete project for $125,000 with Traffic Impact Fees
TS-01040	Fremont Ave/Truman Ave Intersection Improvements (School Route Project)	*Traffic Impact Fees*		*$ 10,000*	*$ 10,000*								There is no school route at Fremont & Truman
TS-01041	Los Altos Ave/Santa Rita School Crossing Improvements (School Route Project)	CIP		$ 10,000		$ 10,000							Needs further study once kids back in school full-time (post-COVID19). Recommend using Traffic Impact Fees
		Traffic Impact Fees			*$ 10,000*								
TS-01052	Annual Bicycle/Pedestrian Access Improvements	CIP		$ 350,000		$ 350,000	$ 350,000		$ 350,000	$ 350,000	$ 350,000	$ 350,000	Fund CSMP in FY19/20 for $165K. Recommend using Traffic Impact Fees instead of CIP.
		TDA Article III Grant		$ 50,000	$ 50,000		$ 50,000	$ 50,000		$ 50,000	$ 50,000	$ 50,000	
		Traffic Impact Fees		*$ 100,000*	*$ 115,000*		*$ 100,000*		*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	
TS-01055	Fremont Ave Pedestrian Bridge Rehabilitation	CIP	$ 250,000			$ 250,000							Can be deferred for a while, per 2016 study. MSC made some repairs in 2017. Condition continues to be monitored.
TS-01057	In-Road Light System Maintenance	CIP	$ 75,000		$ 75,000		$ -	$ 300,000					This technology not very robust. Lots of community-will to repair the defective X-walks. $375K
Totals		**Sources**	**$1,691,000**	**$ 5,017,000**	$ 3,910,000	**$ 2,087,000**	**$4,610,000**	**$ 6,541,000**	**$ 955,000**				**+ $805,000 = $2,842,000. This is $1,458,000 short of the goal to reduce the General Fund CIP by $2M, preserve funds for the Adopted 2019/20 and 2020/21 Revised**
		General Fund	**$1,691,000**	**$ 2,857,000**	$ 1,175,000	**$ 2,037,000**	**$2,560,000**	**$ 3,855,000**	**$ 805,000**				
		Traffic Impact Fees	**0**	**$ 210,000**	$ 885,000	**$ 50,000**	**$ 200,000**	**$ 500,000**	**$ 150,000**				
		Outside Funding	**0**	**$ 1,950,000**	$ 1,850,000	**$ -**	**$1,850,000**	**$ 2,186,000**	**$ -**				

<u>Essential Budget Needs</u>
Reduce CIP by $2M in FYs 19/20 and 20/21
Carve out $1.75M for Fremont Ave. Resurfacing

DISCUSSION ITEM

Agenda Item # 11

MEMO

Meeting Date: October 27, 2020

Subject: Finance Subcommittee

Prepared by: Council Member Anita Enander

Below is suggested language for Council to consider if deciding to create an ad hoc committee.

Council will establish an ad hoc committee consisting of two council members, two members (chair and vice chair?) of the Finance Commission, and the Administrative Services Director. The purpose is to identify more effective processes to compile, present, and evaluate financial information on both routine and exception bases that will improve the quality and timeliness of financial decision-making for the city. A status report will be presented at the November 24 council meeting, at which time Council may give further direction.