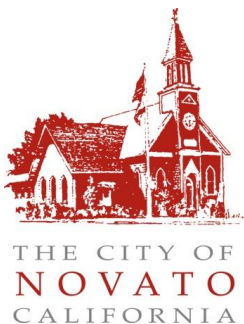


DOCKETED

Docket Number:	16-BSTD-07
Project Title:	Local Ordinance Applications - 2016 Standards
TN #:	215805
Document Title:	City of Novato Local Ordinance Application
Description:	N/A
Filer:	Ingrid Neumann
Organization:	California Energy Commission
Submitter Role:	Commission Staff
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Docketed Date:	2/7/2017



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January 23, 2017

Ingrid Neumann
California Energy Commission
1516 Ninth Street MS-37
Sacramento, CA 95814-5514

RE: Application for Locally Adopted Energy Standards by the City of Novato

Dear Ingrid:

In accordance with Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards, this package of materials includes the City of Novato's adopted local ordinance requiring more stringent energy requirements than those set forth in the 2016 California Building Energy Efficiency Standards Title 24, Part 6. Please find the following materials enclosed:

1. Executed Ordinance 1612 adopting the 2016 California Building Standards Code and local amendments, including requirements for energy reach standards beyond Title 24, Part 6 baseline for new residential and multifamily construction,
2. City staff report to the City Council for adoption of the 2016 California Building Standards Code and local amendments,
3. A cost effectiveness study showing the expected energy savings for an additional 15% reduction in the Title 24, Part 6 energy budget for single-family and multifamily new construction in Climate Zone 2.

Please let me know if you have any questions or require any other documentation.

Sincerely,

Robert M. Brown
Community Development Director
415-899-8938

CITY COUNCIL OF THE CITY OF NOVATO

ORDINANCE NO. 1612

AN ORDINANCE AMENDING SECTION 4-1, OF CHAPTER IV BUILDING AND HOUSING, OF THE NOVATO MUNICIPAL CODE IN ORDER TO ADOPT BY REFERENCE THE 2016 CALIFORNIA BUILDING STANDARDS CODE AS AMENDED AS THE CONSTRUCTION CODES OF THE CITY OF NOVATO AND MAKING FINDINGS OF FACT BASED ON LOCAL CONDITIONS IN SUPPORT OF THE AMENDMENTS

THE CITY COUNCIL OF THE CITY OF NOVATO DOES ORDAIN AS FOLLOWS:

SECTION 1: Subsection 4-1.2.1 of Section 4-1 of Chapter 4 of the Novato Municipal Code is amended to read as follows:

4-1.2.1 Findings. The City of Novato finds pursuant to Health and Safety Code Section 17958.7 the adoption of the 2016 California Building Standards Code with amendments is needed and is reasonably necessary because of local climatic, geographic and topographic conditions and factual findings set forth by the Findings of Fact for Adoption of the 2016 California Building Standards Code with Amendments Based on Local Conditions, which is attached as *Exhibit "A"* and incorporated into this section as if set forth in full.

SECTION 2: Subsection 4-1.3 of Section 4-1 of Chapter 4 of the Novato Municipal Code is removed and replaced to read as follows:

4-1.3 Construction Codes. The city hereby adopts by reference the 2016 Edition of the California Building Standards Code, which is incorporated by reference into Title 24 of the California Code of Regulations, as the Construction Codes of the City of Novato, which shall be specifically comprised of all of the following:

- a. Part I of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Administrative Code published by the International Code Council.
- b. Part 2 of Title 24 of the California Code of Regulations, also referred to as Volumes 1 and 2 of the 2016 Edition of the California Building Code (which incorporates by adoption a California version of the 2015 Edition of the International Building Code published by the International Code Council) with the following amendments:
 1. Chapter 1 Division I is deleted with the exception of sections 1.1.3, 1.1.8, 1.1.8.1, 1.8.3.1 and 1.9.1.5;

2. Chapter 1 Division II, the text of section 105.2 Building: 1. is deleted and replaced to read as follows: One-story detached accessory structures used as tool and storage sheds, playhouses and similar uses, provided the floor area does not exceed 120 square feet (11 m²), the height does not exceed 8 feet, the structure is not located in the required zoning code setbacks, there are no other exempt accessory structures on the parcel, and there is no electrical or plumbing services;
 3. Chapter 1 Division II, Section 105.2 Building: 4 is deleted;
 4. All references in Section 1505 to Class C roof, including assemblies in Table 1505.1^a are replaced with a minimum of Class B roof assemblies;
 5. The first sentence of Section 3109.3 is deleted and replaced to read as follows: Public swimming pools shall be completely enclosed by a fence of at least 5 feet in height or a screen enclosure.
 6. The first sentence of Section 3109.4.1 is deleted and replaced to read as follows: The top of the barrier shall be at least 60 inches above grade measured on the side of the barrier that faces away from the swimming pool;
 7. All appendices are deleted with the exception of Appendix A Section A101.1 (Building Official) and Appendices G (Flood-Resistant Construction), H (Signs), I (Patio Covers) and J (Grading);
- c. Part 2.5 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Residential Code (which incorporates by adoption a California version of the 2015 Edition of the International Residential Code published by the International Code Council) with the following amendments:
1. Chapter 1 Division I is deleted with the exception of sections, 1.1.8, 1.1.8.1, and 1.8.3.1;
 2. Chapter 1 Division II, the first sentence of section R105.2 Building: 1 is deleted and replaced to read as follows: One-story detached accessory structures used as tool and storage sheds, playhouses and similar uses, provided the floor area does not exceed 120 square feet (11 m²), the height does not exceed 8 feet, the structure is not located in the required zoning code setbacks, there are no other exempt accessory structures on the parcel, and there is no electrical or plumbing services;
 3. Section R105.2 Building: 3 (Retaining Walls) in Chapter 1 Division II is deleted;
 4. Section R105.2 Building: 10 (Decks) in Chapter 1 Division II is deleted;

5. Section R202 (Definitions) in Chapter 1 Division II is amended to add:

SUBSTANTIAL REMODEL. Substantial remodel shall mean the renovation of any structure which combined with any additions to the structure, performed within any three (3) year period, affects a floor area which exceeds fifty percent (50%) of the existing floor area of the structure. When any structural changes are made to the building, such as walls, columns, beams or girders, floor or ceiling joists and coverings, roof rafters, roof diaphragms, foundations, piles or retaining walls or similar components, the floor area affected by such changes shall be included in computing floor areas for purposes of applying this definition. This definition does not apply to the replacement and upgrading of residential roof coverings or exterior wall finishes.

6. The text of Section R313.1 in Chapter 1, Division II is deleted and replaced to read as follows:

An automatic residential fire sprinkler system shall be installed in all newly constructed townhouses and in existing townhouses where alterations and/or additions to the existing structure qualifies as a Substantial Remodel as defined in this code. Any addition to a building with an existing fire sprinkler system shall have that system extended to the new portion(s) of the building irrespective of the size of the addition.

7. The text of Section R313.2 in Chapter 1, Division II is deleted and replaced to read as follows:

An automatic residential fire sprinkler system shall be installed in all newly constructed one and two family dwellings and in existing one and two family dwellings where alterations and/or additions to the existing structure qualifies as a Substantial Remodel as defined in this code. Any addition to a building with an existing fire sprinkler system shall have that system extended to the new portion(s) of the building irrespective of the size of the addition.

8. All references in sections R902.1, R902.1.3 to Class C roof covering are replaced with a minimum of Class B roof covering;
9. All appendices are deleted with the exception of Appendix C (Direct Vent Systems), H (Patio Covers), J (Existing Buildings & Structures), K (Sound Transmission, and G (Swimming Pools, Spas, Hot Tubs) with the first sentence of section AG105.2 1. being deleted and replaced to read as follows: The top of the barrier shall be at least 60 inches above grade measured from the side of the barrier which faces away from the swimming pool.

- d. Part 3 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Electric Code (which incorporates by adoption a California version of the 2014 Edition of the National Electric Code of the National Fire Protection Association);
- e. Part 4 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Mechanical Code (which incorporates by adoption a California version of the 2015 Edition of the Uniform Mechanical Code published by the International Association of Plumbing and Mechanical Officials);
- f. Part 5 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Plumbing Code (which incorporates by adoption a California version of the 2015 Edition of the Uniform Plumbing Code published by the International Association of Plumbing and Mechanical Officials);
 - 1. All appendices are deleted with the exception of Appendix H (Private Sewage Disposal Systems)
- g. Part 6 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Energy Code published by the International Code Council;
- h. Part 8 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Historical Building Code published by the International Code Council;
- i. Part 9 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Fire Code (which incorporates by adoption a California version of the 2015 International Fire Code published by the International Code Council) as amended by Novato Fire Protection District Ordinance 2016-1, provided that the City Council ratifies said ordinance after its adoption;
- j. Part 10 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Existing Building Code (which incorporates by adoption a California version of the 2015 International Existing Building Code published by International Code Council);
- k. Part 11 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Green Building Standards Code with the following amendments: For new residential construction only, adopt as mandatory measures the following divisions of Appendix A4 only; Division A4.1(Planning and Design), Division A4.2 (Energy Efficiency), Division A4.3 (Water Efficiency and Conservation), Division A4.4 (Material Conservation and Resource Efficiency), Division A4.5 (Environmental Quality) and Division A4.6 (Voluntary Tiers) including Tier 1 measures only. For new nonresidential construction only, adopt following divisions of Appendix A5; Division A5.1(Planning & Design), Division A5.3 (Water Efficiency & Conservation), Division

A5.4 (Material Conservation and Resource Efficiency), Division A5.5 (Environmental Quality) and Division A5.6 (Voluntary Tiers) including Tier 1 measures only.

1. Part 12 of Title 24 of the California Code of Regulations, also referred to as the 2016 Edition of the California Referenced Standards Code published by the International Code Council.

m. The 2015 International Property Maintenance Code published by the International Code Council

SECTION 3: Sections 4-13, 4-16 and 4-17 of the Novato Municipal Code hereby remain deleted.

SECTION 4: The City Council finds that the adoption of this ordinance is exempt from the California Environmental Quality Act ("CEQA") pursuant to Title 14, Chapter 3 California Code of Regulations, Section 15061(b) (3) in that it can be seen with certainty that there is no possibility that the adoption of this ordinance will have a significant effect on the environment. The ordinance adopts standard codes in effect pursuant to state law and sets requirements for compliance. The adoption of this ordinance does not entitle new development or any changes to the physical environment.

SECTION 5: Severability. If any section, subsection, sentence, clause, phrase, or portion of this ordinance is for any reason held invalid or unconstitutional, such decision shall not affect the validity of the remaining portions of this ordinance.

The City Council hereby declares that it would have passed this and each section, subsection, phrase, or clause thereof irrespective of the fact that any one or more sections, subsections, phrases, or clauses be declared unconstitutional on their face or as applied.

SECTION 6: Effective Date. This ordinance shall become effective 30 days after the date of adoption, or January 1, 2017, whichever comes later.

SECTION 7: Posting. This ordinance shall be published in accordance with applicable provisions of law, by either:

publishing the entire ordinance once in a newspaper of general circulation, published in the City of Novato, within fifteen (15) days after its passage and adoption, or

publishing the title or appropriate summary in a newspaper of general circulation, published in the City of Novato, at least five (5) days prior to adoption, and a second time within fifteen (15) days after its passage and adoption with the names of those City Councilmembers voting for and against the ordinance.

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THE FOREGOING ORDINANCE was first read at a regular meeting of the Novato City Council on the 15th day of November, 2016, and was passed and adopted at a regular meeting of the Novato City Council on the 29th day of November, 2016.

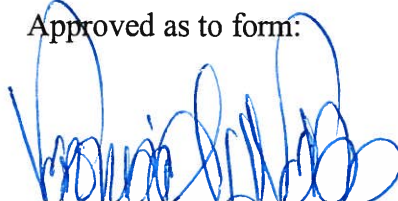
AYES:	Councilmembers	Athas, Drew, Fryday, Lucan, Eklund
NOES:	Councilmembers	None
ABSTAIN:	Councilmembers	None
ABSENT:	Councilmembers	None



Mayor of the City of Novato

Attest: 

City Clerk of the City of Novato

Approved as to form:


City Attorney of the City of Novato

EXHIBIT “A”

FINDINGS OF FACT FOR ADOPTION OF THE CALIFORNIA BUILDING CODES WITH AMENDMENTS AS THE CITY OF NOVATO CONSTRUCTION CODES BASED ON LOCAL CONDITIONS

CHANGES OR AMENDMENTS: Pursuant to Section 1.1.8.1 of Part 2 of Title 24 of the California Code of Regulations, also known as the California Building Code, and Section 1.1.8.1 of Part 2.5 of Title 24 of the California Code of Regulations, also known as the California Residential Code, and Section 101.7.1 of Part 11 of Title 24 of the California Code of Regulations, also known as the California Green Building Standards Code, the City Council of the City of Novato makes express, local findings set forth by this exhibit in adopting and amending the 2017 California Building Code (Title 24, Parts 2, 2.5 and 11) as it pertains to the regulation of construction of residential and non-residential buildings and accessory structures within the City of Novato.

FINDINGS: Pursuant to Section 17958.7 of the State of California Health and Safety Code, the City Council of the City of Novato has determined and finds that the attached amendments and changes to the 2017 California Building Code, the 2017 California Residential Code and 2017 California Green Building Standards Code are needed and are reasonably necessary because of local climatic, geographic or topographic conditions.

LOCAL CONDITIONS: Local conditions have an adverse effect on the efficient design of non-residential buildings to improve the public health, safety and general welfare of the occupants of such buildings within the City of Novato.

Below are listed adverse local climatic, geographic and topographic conditions:

1. Climatic

a. Precipitation. Precipitation ranges from 15 to 42 inches per year with an average of approximately 27 inches per year. Approximately ninety percent (90%) falls during the months of November through April, and 10% from May through October. The lack of adequate water from precipitation within the city makes green building standards necessary to implement water conservation in non-residential buildings from which all persons in the City of Novato would benefit.

b. Relative Humidity. Humidity generally ranges from 50% during daytime to 86% at night. It drops to 20% during the summer months and occasionally drops lower. The range of humidity experienced by occupants of non-residential buildings makes green building standards necessary to implement energy efficiency in non-residential buildings.

c. Temperatures. Temperatures have been recorded as high as 110 degrees F. (6-15-61) and as low as 20 degrees F. (12-22-90). Average summer highs are the 78 degree to 85

degree range and the average winter time lows are in the 38 degree to 44 degree range. The City's Climate Action Plan (2015) estimates continued warming due to concentrations of greenhouse gases in the atmosphere. Greenhouse Gas Emission Reduction Measure 9 calls for implementation of CALGreen Tier 1 with anticipated energy savings of 231 metric tons of CO₂ equivalents/year by year 2020, and Reduction Measure 10 calling for increased solar power generation in new construction, resulting in anticipated energy savings of 1,411 metric tons of CO₂ equivalents/year by year 2020. The range of temperatures experienced and anticipated by the city makes green building standards necessary to promote efficiency in the use of heating and air conditioning in residential buildings.

d. Winds. Prevailing winds are from the northwest. However, winds are experienced from virtually every direction at one time or another. Velocities are generally in the 5- 15 mph range, gusting to 7.4 – 30 mph, particularly during the summer months. Extreme winds up to 50 mph have been known to occur. The high velocity and various directions of winds within the city make green building standards necessary to promote energy efficiency by utilizing wind velocity and wind direction in non-residential buildings.

2. Geographic and Topographic.

a. Size and Population. The City of Novato incorporated January 20, 1960, covers 28 square miles. The State of California estimates Novato's population at 54,194 as of January 1, 2013. There is a limited amount of vacant land suitable for expansion or development because of the topography of the city. The majority of existing non-residential development was constructed from 1960 to 2000. The limited amount of vacant land upon which residential and non-residential development may be expanded creates a need for green building standards in order to ensure energy efficient and environmentally friendly development of property within the city.

b. Topography. The City of Novato is a conglomeration of bay plains, hills, valleys and ridges. The flatter lands (0 – 5% slope) are found in the central, eastern and south-eastern portions of the City and there is a mixture of residential and non-residential development on these lands. The large number of parcels on hillsides created the need for various types and heights of retaining walls to allow greater use of the land. Previous failures of unregulated low retaining walls requires such walls to be regulated via permit to promote safe construction standards. The varied topography of the city creates the need for green building standards to promote efficiency and conservation in energy and water use for residential and non-residential building occupants.

c. Water Resources. The North Marin Water District provides the City of Novato with water from three sources. The Russian River in Sonoma County supplies 80 percent of the water to the North Marin Water District and the remaining 20 percent come from Stafford Lake Water Treatment Plant located just west of the city. The third source, a newly completed recycled water plant in cooperation with the Novato Sanitary District that is currently in phase 1, supplies irrigation water to a nearby golf

course. The recycled water plant will eventually replace 85 million gallons of potable water for irrigation purposes. The scarcity of water sources to provide residents and occupants of the city with adequate water supply requires that greenbuilding standards be implemented in residential and non-residential buildings to promote water conservation from which all persons in the City of Novato would benefit.

3. Summary.

The above local climatic, geographic and topographic conditions provide sufficient needs for the City of Novato to adopt local amendments for the building codes and green building codes to improve public health, safety and general welfare by enhancing the design and construction of buildings creating a positive environmental impact and sustainable construction practices.

The large number of inground swimming pools, private and public have shown the increased barrier height to 60 inches from 48 inches has limited small children drowning over the years since this increased height has been in effect.

The State of California does not have regulations other than Title 24 Energy Codes that mandate existing buildings increase energy efficiency or to be operated sustainably. The 2016 Green Building Standards Code will go into effect on January 1, 2017 and requires local adoption if amended. The proposed adoption of portions of the residential and nonresidential appendixes will make these voluntary measures, mandatory. There will be new construction activity that would benefit the environment with the adoption of these green building measures.

The City of Novato has a large inventory of older residential and non-residential buildings and if expansion of these existing residential and non-residential buildings is submitted to the city, the goal should be to increase energy efficiency, water efficiency, and conservation, along with material conservation, resource efficiency and environmental air quality. The limited land for new residential and non-residential development should also be enhanced by these more efficient sustainable practices with the adoption of this code. The promotion of energy efficiency, water efficiency and conservation in residential and non-residential buildings will result in more available and environmentally friendly energy and water resources which city residents and occupants may utilize. The availability of more and better resources will benefit all residents and occupants of the city and preserve the quality of the environment within the city as well.

The City of Novato has a multi-family annual inspection program for the 3000 plus rental units within the city. The adoption of the 2015 International Property Maintenance Code will provide the City's Code Enforcement Division with additional tools to help maintain the high level of service they provide to the property owners and tenants.

STAFF REPORT



THE CITY OF
NOVATO
CALIFORNIA

MEETING

DATE: November 15, 2016

TO: City Council

FROM: Annette Chavez, Chief Building Official

PRESENTER: Annette Chavez, Chief Building Official

922 Machin Avenue
Novato, CA 94945
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FAX (415) 899-8213
www.novato.org

SUBJECT: **AMENDMENT OF THE NOVATO MUNICIPAL CODE TO INCORPORATE THE 2016 CALIFORNIA BUILDING STANDARDS CODE WITH LOCAL AMENDMENTS AND ADOPTION OF A RESOLUTION RATIFYING NOVATO FIRE PROTECTION DISTRICT'S ORDINANCE 2016-1 AMENDING THE 2016 FIRE CODE**

REQUEST

Consider incorporating the 2016 California Building Standards Code with local amendments into the Novato Municipal Code; adopting the 2016 California Green Building Standards Code with local amendments; adopting the 2015 International Property Maintenance Code; and, adopting a resolution ratifying Novato Fire Protection District amendments to the 2016 California Fire Code.

RECOMMENDATION

1) Introduce and waive further reading of an ordinance amending section 4-1 and deleting sections 4-13, 4-16, 4-17 of Chapter IV to adopt the 2016 California Building Standards Code with local amendment; 2) Set a public hearing on the adoption by reference of the 2016 California Building Standards Code with local amendments for the same date as the second reading of the ordinance on November 29, 2016; and 3) Adopt a resolution ratifying Novato Fire Protection District Ordinance 2016-1 adopting the 2016 California Fire Code with local amendments.

DISCUSSION

The California Code of Regulations, Title 24, also referred to as the California Building Standards Code consists of Parts 1 (Administrative Code), 2 (Building Code), 2.5 (Residential Code), 3 (Electric Code), 4 (Mechanical Code), 5 (Plumbing Code), 6 (Energy Code), 8 (Historical Building Code), 9 (Fire Code), 10 (Existing Building Code), 11 (Green Building Standards Code) and 12 (Referenced Standards Code). The adoption process takes place every three years and the latest update was published by the state on July 1, 2016. Local jurisdictions have 180 days from July 1st to make more restrictive amendments to the codes based on local

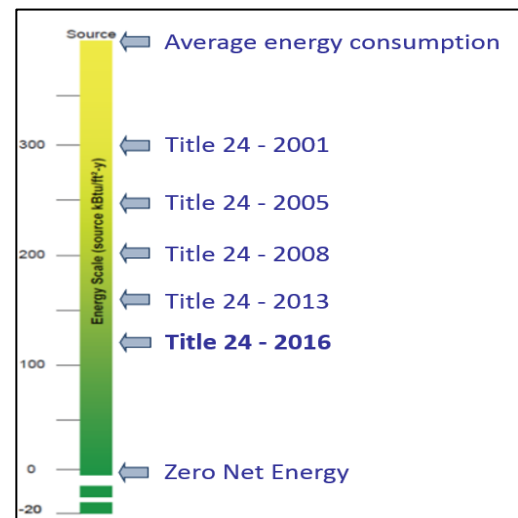
Novato City Council Agenda Staff Report Date: _____ File No. _____

climatic, geological, or topographical conditions. If amendments are not adopted by the local jurisdiction, then the California Building Standards Codes go into effect by default on January 1, 2017. City staff has proposed only a few local amendments based on conditions within our community. Attachment #3 provides a summary of the staff proposed local amendments. The Fire District has also proposed some modifications to the Fire Code section of the California Building Standards Code as discussed below.

Green Building Standards

In 2010 the California Building Standards Code included mandatory green building requirements, referred to as CAL Green. These original measures addressed only new construction and not remodels/additions. Several Marin jurisdictions met with building industry representatives in 2009 and developed a model green building ordinance that went beyond the 2010 CAL Green code provisions, which was ultimately adopted by four jurisdictions including Novato, San Rafael, Marin County and San Anselmo. This process, known as BERST, produced regulations that utilized two existing green building rating systems: Green Point Rated for residential and LEED for commercial or residential. The model ordinance required incorporation of more green features and a reduced energy budget as the size and/or valuation of the development project increased.

The 2013 CAL Green Code was updated to regulate both new and remodeled/expanded residential and non-residential buildings. The energy requirements of Title 24 were made significantly more stringent (an approximately 25% reduced energy budget for new homes, 30% reduction for commercial buildings and a 14% reduction for multi-family structures), with an intended progression towards code requirements for net zero energy homes by 2020 and commercial structures by 2030. The following chart indicates the relative increase in building energy efficiency requirements over the past several code cycles.



The City of Novato chose to eliminate the BERST model and adopted 2013 CAL Green Tier 1 for new construction only, but did not adopt the additional 15% further reduction in the energy budget due to a lack of an available cost effectiveness analysis, which is required for local code amendments which affect energy requirements and must be subsequently approved by the California Energy Commission (CEC).

The 2016 CAL Green Code makes relatively few modifications to the 2013 version with the following major exceptions:

- The energy budget for new buildings has been reduced again, generally by 25% for residential structures and 30% for non-residential buildings. Each successive code adoption has reduced the allowable energy use in new buildings towards the state goal of requiring “zero net energy” residential buildings by 2020 and non-residential buildings by 2030. The additional reduction in the energy budget in the 2016 code will be challenging to achieve, and in many cases may necessitate inclusion of solar panels.

- The recycling of construction and demolition waste has been increased from 50% to 65% of total project waste.
- Areas of recycling facilities must be provided in new multi-family projects of 5+ units.
- A higher proportion of designated parking spaces (from 3% to 6%) in new non-residential developments must have electrical conduit pre-installed to allow future installation of charging stations.
- All energy efficiency improvements required of building alterations have been eliminated, requiring efficiency upgrades only when new heating/cooling or domestic hot water systems are added to a building, not replaced.

Staff is recommending that Novato adopt the 2016 Green Building Standards Code including Tier 1 for new construction. For building additions, staff believes that some aspects of Tier 1 provisions may be difficult to achieve for the smaller scope of construction associated with additions, and would have limited applicability since few buildings add an entirely new HVAC or hot water system which triggers the new energy requirements.

In addition, staff recommends that the additional Tier 1 reduction in energy budget of 15% also be adopted for new residential construction (both single-family and multi-family) since a cost-effectiveness study has been prepared by PG&E for our climate zone which found sufficient cost/benefit to garner CEC approval, but a cost-effectiveness study has not been prepared for non-residential structures. However, it should be pointed out that achieving the additional energy efficiency in new dwellings will be challenging. The base California Building Code has progressively decreased the allowable energy budget, and it is expected that building efficiency measures beyond a very well insulated and sealed building envelope and efficient lighting and appliances will be necessary to achieve the 2016 code with the Tier 1 additional reduction of 15%, such as inclusion of solar panels. Among Marin jurisdictions, it seems many will be adopting the Tier 1 requirements for new construction, but all but the County and Mill Valley will exclude the Tier 1 additional 15% energy reduction.

The City's Climate Action Plan includes Measure 8 which calls for adoption of a local code amendment requiring the additional 15% energy savings beyond the base CAL Green code, and Measure 7 calls for increasing the proportion of local solar energy generation.

In preparation for adoption of the 2016 CAL Green code, staff members from most jurisdictions in Marin discussed the potential for adopting more uniform green building provisions (such as Tier 1). In addition, staff explored the potential for adopting "reach code" requirements that exceed those in CAL Green with assistance from green building experts at Build It Green (funded by PG&E). The "reach code" provisions that staff explored include:

- **Mandatory PV Solar for New Buildings:** This provision would require a minimum wattage of photovoltaic energy production for new buildings, including single family residences. Very few California jurisdictions have adopted such a standard (Santa Monica, Sebastopol, San Francisco, Landcaster). The challenge with such a standard is to determine how to address properties that do not have adequate solar access.
- **Mandatory Building Upgrades for Existing Buildings at Resale:** This provision would mandate a specified level of energy savings through upgrades when a building is sold or within a defined time period after sale. Again, few cities have such provisions (notably Berkeley and Boulder, CO), the costs of enforcement are considerable and realtors dislike any mandates that complicate property sales.

- **Mandatory Home Energy Efficiency Rating and Disclosure for Existing Single-Family Dwellings:** This provision would mandate single-family property owners to obtain an assessment of an existing building's energy efficiency using a rating tool such as the EPA's Home Energy Score, either at the time of sale or when major renovations are applied for, to inform new buyers or owners of the relative efficiency of the dwelling and cost/benefits of potential upgrades.

The timing of the code adoption cycle did not allow sufficient time to fully research and discuss these additional "reach codes" in conjunction with the mandatory code adoption. Marin County staff have committed to assisting other Marin jurisdictions in doing further analysis of these potential measures for adoption in 2017 if desired. Expressions of Council interest, or lack thereof, in considering these additional "reach codes" would be helpful prior to devoting additional staff resources.

Local Amendments

Most of the regulations in the California Building Standards Code are proposed to be adopted as written. There are some minor changes proposed as shown in a summary as Attachment #3 which are included primarily to incorporate existing provisions of Novato's Code into the new regulations.

The California Government Code provides that any city adopting by reference a separate set of published or enacted codes, as is now being proposed, set a public hearing after the introduction of the ordinance which would be conducted prior to its adoption. Notice of the public hearing is to be published at least 14 days in advance of the hearing date. Staff is requesting that the City Council set a public hearing for December 3, 2013, on which date the ordinance would also be considered for adoption. If adopted at the City Council meeting on November 29, the ordinance would take effect on January 1, 2017.

The Fire District is also proposing local amendments to the State Fire Code and staff requests that the City Council also consider these amendments as provided in Attachment #3. To implement the District's proposed amendments to the 2016 California Fire Code, the City Council need only ratify the Novato Fire Protection District's Ordinance 2016-1. This Resolution is attached with a summary from the Fire District describing the amendments.

FISCAL IMPACT

None

ALTERNATIVES

Take no action and the codes will be adopted without local amendments by default.

ATTACHMENTS

1. Amended Ordinance 4-1, Section 4-1.3 Construction Codes
2. Exhibit "A" Findings of fact for Ordinance 4-1
3. Resolution ratifying N.F.P.D. Ordinance 2016-1
4. Summary of amendments to Section 4-1.3 NMC

CA Statewide Codes and Standards Program

Title 24, Part 11
Local Energy Efficiency Ordinances

CALGreen Cost Effectiveness Study

Prepared for:

Marshall Hunt
Codes and Standards Program
Pacific Gas and Electric Company

Prepared by:

Davis Energy Group, Inc.
Enercomp, Inc.
Misti Bruceri & Associates, LLC

Last Modified: September 2, 2016

LEGAL NOTICE

This report was prepared by Pacific Gas and Electric Company 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, 2016b) is maintained and updated every three years by two state agencies, the California Energy Commission (CEC) 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 CEC and file the ordinance with the BSC for the ordinance to be legally enforceable.

This report presents the results from analysis of the feasibility and cost-effectiveness of requiring new low-rise single family and multifamily residential construction to exceed the 2016 Building Energy Efficiency Standards, which become effective January 1, 2017. The analysis includes scenarios of compliance packages options and cost effectiveness analysis for all sixteen California climate zones. Four levels of building energy performance were examined:

- (1) exceeding the minimum requirements by at least 15%, consistent with the voluntary Tier 1 Performance Standard in Title 24, Part 11 (CALGreen),
- (2) exceeding minimum requirement by at least 30%, consistent with the voluntary Tier 2 Performance Standard in CALGreen,
- (3) meeting minimum Title 24 efficiency performance targets plus on-site renewable energy generation sufficient to achieve an Energy Design Rating of zero (TDV-Zero), consistent with the voluntary Zero Net Energy Design tier in CALGreen,
- (4) meeting minimum Title 24 efficiency performance targets plus on-site renewable energy generation sized to offset a portion of the total TDV loads of the building without risking sizing of the PV system larger than the estimated electrical energy use of the building.

2 Methodology and Assumptions

2.1 *Building Prototypes*

The CEC defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. There exist two single family prototypes and one multifamily prototype, all three of which are used in this analysis in development of the above-code efficiency packages. Table 1 describes the basic characteristics of each prototype. Additional details on the prototypes can be found in the ACM Approval Manual (CEC, 2016a).

Table 1: Prototype Characteristics

	<u>Single Family One-Story</u>	<u>Single Family Two-Story</u>	<u>Multifamily</u>
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%

Additionally, each prototype building has the following features:

- Slab-on-grade foundation
- Vented attic. High performance attic in climates where prescriptively assigned (CZ 4, 8-16) with insulation installed below roof deck. Refer to Table 150.1-A in Appendix A.
- Ductwork located in the attic for single family homes and in conditioned space for multifamily.
- Split-system gas furnace with air conditioner that meet the minimum federal guidelines for efficiency
- Tankless gas water heater that meets the minimum federal guidelines for efficiency; individual water heaters in each multifamily apartment.

Other features are defined consistent with the Standard Design in the Alternative Calculation Method Reference Manual (CEC, 2016d), designed to meet, but not exceed, the minimum requirements.

The CEC's standard protocol for the 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% single-story homes and 55% two-story homes. Simulation results in this study are therefore characterized according to this ratio, which is approximately equivalent to a 2,430 ft² house¹.

2.2 Efficiency Measures & Package Development

The CBECC-RES 2016.2.0 ALPHA2² (833) compliance simulation tool was used to evaluate energy impacts using the 2016 prescriptive standards as the benchmark and the 2016 time dependent valuation (TDV) values. TDV is the energy metric used by the CEC since the 2005 Title 24 energy code to evaluate compliance with the Title 24 standards. TDV values energy use differently depending on the fuel source (gas, electricity, and propane), time of day, and season. TDV was developed to reflect the “societal value or cost” 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 such as projected costs for carbon emissions. Electricity used (or saved) during peak periods of the summer has a much higher value than electricity used (or saved) during off-peak periods (Horii et al, 2014).

The methodology used in the analyses for each of the prototypical building types begins with a design that precisely meets the minimum 2016 prescriptive requirements (0% compliance margin). A table of prescriptive measures used in each base design by climate zone is located in Appendix A. Using the 2016 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 runs³ were conducted to develop packages of measures that exceed the minimum code performance level by 15% (CALGreen Tier 1), and 30% (Tier 2). The consultants authoring this study selected packages and measures based on decades of experience with residential architects, builders, and engineers along with general knowledge of the relative acceptance and preferences of many measures, as well as their incremental costs.

¹ 2,430 ft² = 45% * 2,100 ft² + 55% * 2,700 ft²

² On June 14, 2016 the CEC approved CBECC-Res 2016.2.0 Version of the software. The version used for this study is nearly identical to the approved version with the exception of minor changes that do not affect the cost effective analysis of the measures evaluated.

³ Using the “quick” simulation speed option.

Evaluation results for the selected packages show that meeting the performance targets for both single family and multifamily prototypes is feasible in most climate zones. In climates where it was not feasible, targets were relaxed to an appropriate level. It is important to note that the packages contained in this report are examples only; any project meeting requirements of a local ordinance, both single family and multifamily, must independently evaluate and identify the most cost effective approach based on project-specific factors.

Following are descriptions of each of the efficiency measures applied in this analysis.

Quality Insulation Installation (QII): HERS rater verification of insulation quality according to the procedures outlined in the 2016 Reference Appendices RA3.5 (CEC, 2016c). QII is included in all cases since it is a pre-requisite for all the voluntary tiers in 2016 CALGreen.

Reduced Infiltration (ACH50): HERS rater field verification and diagnostic testing of building air leakage according to the procedures outlined in the 2016 Reference Appendices RA3.8 (CEC, 2016c). The default infiltration assumption for single family homes is 5 air changes per hour at 50 Pascals (ACH50)⁴ and the reduced level applied in this analysis is 3 ACH50. This measure was not applied to multifamily homes because the modeling software does not allow this credit unless each unit is modeled individually, which is not typical in the compliance process for multifamily buildings.

Window Performance: Reduce window U-value from the prescriptive value of 0.32 to 0.30 in all climates and reduce the solar heat gain coefficient (SHGC) from the prescriptive value of 0.25 to 0.23 in climate zone 2, 4, 6 through 16. In climate zones 1, 3, and 5 there is no prescriptive SHGC requirement and the default value of 0.50 is left as is.

Door Performance: Install insulated doors that meet a U-value of 0.20 at the front entry and doors between the house and garage. It's assumed there is a single 3' x 6'8" entry door per single family home and multifamily unit as well as a second 3' x 6'8" door to the garage per single family home.

Cool Roof: Install a roofing product that's rated by the Cool Roof Rating Council to have an aged solar reflectance of 0.20. This measure only applies to climates zones where this is not already required prescriptively.

Exterior Wall Insulation: Increase wall cavity insulation from R-19 to R-21 in 2x6 walls.

High Performance Attics (HPA): For climates where HPA is not already prescriptive under the 2016 code (CZ 1-3, 5-7), increase attic ceiling insulation to R-38 and add insulation under the roof deck between framing (R-13 for roof with air space, R-18 for roof without air space).

High Efficiency Furnace: Upgrade furnace to a condensing unit with an efficiency of 92% AFUE.

High Efficiency Air Conditioner: Upgrade air conditioner efficiency beyond federal efficiency minimum to either SEER 15 / EER 12.5 or SEER 16 / EER 13.

High Efficacy Fan: Upgrade the fan in the furnace or air handler using an electronically commutated motor (ECM) that meets an efficacy of 0.3 Watts / cfm or lower operating at full speed. Fan watt draw is verified by a HERS rater according to the procedures outlined in the 2016 Reference Appendices RA3.3 (CEC, 2016c). New federal regulations that go into effect July 3, 2019 are expected to result in equivalent performance for all newly manufactured furnaces provided that the ducts are sized properly.

⁴ Whole house leakage tested at a pressure difference of 50 Pascals between indoors and outdoors.

Refrigerant Charge Verification: HERS rater verification of proper air conditioner refrigerant charge according to the procedures outlined in the 2016 Reference Appendices RA3.2 (CEC, 2016c). This measure only applies to climates zones where this is not already required prescriptively.

R-8 Duct Insulation: Increase duct insulation to R-8. This measure only applies to climates zones where R-8 ducts are not already required prescriptively.

High Efficiency Water Heater: Upgrade tankless water heater to a condensing unit with a rated Energy Factor (EF) of either 0.94 or 0.96.

Hot Water Pipe Insulation: Beginning in January 1, 2017 the 2016 California Plumbing Code will require pipe insulation levels that are close to that required if taking the Title-24 pipe insulation credit. This credit will be obsolete under the 2016 energy code, however, the HERS-Verified Pipe Insulation Credit, as defined in the 2016 Reference Appendices RA3.6.3 (CEC, 2016c), will remain. While CBECC-Res has not yet been updated to reflect this, for this analysis it was assumed that the revised HERS verified credit would be equivalent to the current credit for pipe insulation without HERS verification. This was determined based on simulations that demonstrated the HERS credit to be valued at roughly twice that for pipe insulation without verification in terms of TDV energy. This credit was only applied to single family residences. For costing purposes, 120 linear feet of 1/2in insulated pipe is assumed to be insulated.

Hot Water Compact Distribution: HERS rater verification of compact distribution system requirements according to the procedures outlined in the 2016 Reference Appendices RA3.6.5 (CEC, 2016c). This measure was applied to multifamily buildings only. Many multifamily buildings with individual water heaters are expected to easily meet this credit with little or no alteration to plumbing design. This measure also requires verification of pipe insulation per the HERS-Verified Pipe Insulation Credit. Assumption is 60 linear feet per dwelling unit of 1/2in insulated pipe.

PV Compliance Credit: To be eligible for this compliance credit a PV system with a minimum capacity of 2 kW DC per single family home with no more than 2,000 ft² of conditioned floor area and 1 kW DC per multifamily unit with no more than 1,000 ft² of conditioned floor area is required. For the single family 2,430 ft² prototype the minimum capacity as calculated by CBECC-Res is 2.0 kW to 2.4 kW depending on the climate zone. The multifamily apartment units in the prototype are all under 1,000 ft² and therefore require a 1 kW system. The credit was developed to give builders an option with which to trade-off High Performance Attics and Walls, and to begin preparing for ZNE requirements.

Table 2 below summarizes the measures evaluated along with cost assumptions.

Table 2: Measure Descriptions & Cost Assumptions

Measure	Performance Level	Incremental Cost		Source & Notes
		Single Family	MF – Per Unit	
QII	Yes	\$519	\$133	City of Palo Alto 2016 Reach Code Ordinance: http://www.cityofpaloalto.org/civicax/filebank/documents/52054
ACH50	3.0	\$379	n/a	NREL measure cost database (\$0.115/ft ² for sealing) + HERS rater verification (\$100).
Wall Insulation	R-21	\$164	n/a	2016 CASE Report: Residential High Performance Walls and QII, 2016-RES-ENV2-F
Cool Roof	Aged Reflect = 0.20	\$523	\$131	\$0-\$0.50 / ft ² of roof area per local industry expert at LBNL. Used average of \$0.25/ft ² .
Window U-factor/ SHGC	0.30/0.23	\$73	\$20	EnerComp (\$0.15/ft ² of window area)
Doors	0.20 U-factor	\$210	\$140	NREL measure cost database (\$3.50/ft ²) for doors between house and garage. Double cost (\$7/ft ²) for front door assuming a premium product.
High Performance Attics (HPA)	R-15 under roof deck	\$878	\$219	For climate zones 1-3, & 5-7 only where HPA is not prescriptive. 2016 CASE Report: Residential Ducts in Conditioned Space / High Performance Attics, 2016-RES-ENV1-F
Furnace	92%	\$389	\$351	Local HVAC contractor, MF reduction for smaller capacity.
Air Conditioning	15/12.5	\$78	\$46	Local HVAC contractor, MF reduction for smaller capacity.
	16/13	\$839	\$699	Average of local HVAC contractor & NREL database costs. MF reduction for smaller capacity.
Fan Efficacy	0.3 Watts/cfm	\$143	\$104	Local HVAC contractor, MF reduction for smaller capacity.
Refrigerant Charge	HERS verified	n/a	\$75	Local HERS rater.
Duct Insulation	R-8	\$164	n/a	For climate zones 3, 6, & 7 where not prescriptive. 2016 CASE Report: Residential Ducts in Conditioned Space / High Performance Attics, 2016-RES-ENV1-F
Water heater	0.94 EF	\$0	\$0	Internet pricing and plumbing contractor input. Minimal incremental equip cost and lower cost to install PVC venting (condensing) vs stainless venting (standard). Slight premium going from 0.94 to 0.96.
	0.96 EF	\$100	\$100	
Hot water pipe insulation	HERS verified	\$146	n/a	Roughly equivalent to code requirements effective Jan. 2017. 10% of \$3.87 per ft (2013 SF DHW CASE study) for additional labor to pass HERS inspection. \$100 for HERS verification per local HERS raters.
Hot water compact distribution	HERS verified	n/a	\$112	Assume compact design already or easily achieved in MF units – no added cost. \$100 HERS verification fee per local HERS rater. Pipe insulation cost per the pipe insulation measure assumptions.
PV	System size varies	\$3.53 / kW DC	\$3.21 / kW DC	Avg. system cost for systems < 10kW (for the last 12 months) of \$5.29/Watt for single family (http://www.gosolarcalifornia.ca.gov/). For multi-family systems, an average of the < 10 kW and > 10kW system cost (\$4.37/Watt) was used; systems are expected to be typically greater than 10 kW, although not as large as some commercial systems reported on in the database. In both cases cost was reduced by \$0.25/Watt for the NSHP incentive & 30% for the solar investment tax credit.

2.3 Efficiency Packages

Three efficiency packages were developed for each climate zone where feasible, as described below. Since the federal government does not allow local or state government agencies to require the use of federally-regulated equipment that exceeds the minimum standard requirement, this analysis includes at least one package for each climate zone that does not require installing equipment with higher efficiencies than federally mandated. In climates where the PV Compliance Credit (PVCC) is available (all climates except 6 and 7) a package that includes the PVCC in addition to efficiency measures was evaluated to achieve Tier 2 performance levels.

- 1) **Envelope:** These packages focus on building envelope measures but also include efficient hot water pipe distribution and cooling fan efficiency measures that don't trigger federal preemption issues.
- 2) **Equipment:** Use of HVAC and water heating equipment that are more efficient than federal standards combined with efficient envelope measures if necessary.
- 3) **PV Credit:** Utilize the PV compliance credit (PVCC) available in all climate zones except 6 and 7.

2.4 PV Performance Packages

Using the Tier 2 efficiency package (or Tier 1 in cases where reaching Tier 2 wasn't feasible), the PV system was evaluated and sized to offset TDV loads for the following two conditions:

- 1) **PV-Plus:** Install a PV system sized to offset a portion of the total household energy use based on TDV energy. PV sizing is consistent with the methodology included in the California Energy Commission's proposed Solar PV Ordinance being developed by the CEC, and PV sizing calculations were developed such that PV size is to be equivalent to offsetting approximately 80% of total estimated building electricity use for a gas/electric home built to the 2016 Title 24. Table 3 summarizes the prescriptive PV sizing based on Climate Zone and home size.
- 2) **TDV-Zero:** Install a PV system sized to offset 100% of building energy use based on TDV energy, including appliances and plug loads. This is consistent with the requirements of the CALGreen Zero Net Energy Design tier.

In both these cases PV is evaluated in CBECC-Res according to the California Flexible Installation (CFI).

Table 3: Minimum PV System Size (kW_{DC}) required to meet Solar PV Ordinance by Climate Zone

Conditioned Space (ft ²)	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8	CZ9	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
Less than 1000	1.6	1.4	1.5	1.3	1.4	1.5	1.3	1.5	1.4	1.4	1.7	1.5	1.8	1.3	2.1	1.3
1000 - 1499	2.0	1.7	1.7	1.5	1.6	1.7	1.5	1.8	1.7	1.7	2.2	1.9	2.3	1.6	2.8	1.6
1500 - 1999	2.4	2.0	2.1	1.8	1.9	2.0	1.8	2.1	2.0	2.0	2.7	2.3	2.8	2.0	3.5	1.9
2000 - 2499	2.8	2.3	2.4	2.1	2.1	2.3	2.0	2.4	2.3	2.3	3.2	2.7	3.4	2.3	4.2	2.3
2500 - 2999	3.2	2.6	2.7	2.4	2.4	2.6	2.3	2.7	2.6	2.7	3.7	3.1	3.9	2.7	4.9	2.6
3000 - 3499	3.6	2.9	3.0	2.6	2.7	2.9	2.5	3.0	2.9	3.0	4.2	3.4	4.4	3.0	5.6	3.0
3500 - 3999	3.9	3.2	3.2	2.9	2.9	3.2	2.7	3.3	3.2	3.3	4.7	3.8	4.9	3.4	6.3	3.3
4000 - 4499	4.3	3.5	3.5	3.2	3.1	3.4	2.9	3.6	3.5	3.6	5.1	4.2	5.4	3.7	7.0	3.6

2.5 Cost Effectiveness

A customer based approach to evaluating cost effectiveness was used based on past experience with Reach Code adoption by local governments. The current residential utility rates at the time of the analysis were used to calculate utility costs for all cases and determine cost effectiveness for the proposed packages. Annual utility costs were calculated using hourly electricity and gas output from CBECC-Res and applying the utility tariffs summarized in Table 4. Appendix C includes the utility rate schedules used for this study. The standard residential rate (E1 in PG&E territory, D in SCE territory, & DR in SDG&E) was applied to the base case and all cases without PV systems. The applicable residential time-of-use (TOU) rate was applied to all cases with PV systems.⁵ Any annual electricity production in excess of annual electricity consumption is credited to the utility account at the applicable wholesale rate based on the approved NEM tariffs for that utility. The net surplus compensation rates for the different utilities are as follows:

- PG&E: \$0.043 / kWh
- SCE: \$0.0298 / kWh⁶
- SDG&E: \$0.0321 / kWh⁷

Table 4: IOU Utility Tariffs used based on Climate Zone

Climate Zones	Electric / Gas Utility	Electricity (Standard)	Electricity (Time-of-use)	Natural Gas
1-5, 11-13, 16	PG&E	E1	E-TOU, Option A	G1
6, 8-10, 14, 15	SCE / SoCal Gas	D	TOU-D-T	GR
7	SDG&E	DR	DR-SES	GR

Cost effectiveness was evaluated for all sixteen climate zones and is presented according to lifecycle customer benefit-to-cost ratio. The benefit-to-cost ratio is a metric which represents the cost effectiveness of energy efficiency over a 30-year lifetime taking into account discounting of future savings and financing of incremental costs. A value of one indicates the savings over the life of the measure are equivalent to the incremental cost of that measure. A value greater than one represents a positive return on investment. The ratio is calculated as follows:

Lifecycle Customer Benefit-Cost Ratio =

$$(Annual\ utility\ cost\ savings * Lifecycle\ cost\ factor) / (First\ incremental\ cost * Financing\ factor)$$

The lifecycle cost factor is 19.6 and includes the following assumptions:

- 30-year measure life & utility cost savings
- 3% real discount rate
- No utility rate escalation (conservative assumption)

⁵ 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?>).

⁶ SCE net surplus compensation rate based on 1-year average September 2015 – August 2016.

⁷ SDG&E net surplus compensation rate based on 1-year average August 2015 – July 2016.

The financing factor is 1.068 and includes the following assumptions:

- 30-year financing term
- 4.5% loan interest rate
- 3% real discount rate
- 20% average tax rate (to account for tax savings due to loan interest deductions)

Simple payback is also presented and is calculated using the equation below. Based on the terms described above the lifecycle cost-to-benefit ratio threshold of one is roughly equivalent to a simple payback of 18 years.

$$\text{Simple payback} = \text{First incremental cost} / \text{Annual customer utility cost savings}$$

2.6 Greenhouse Gas Emissions

Equivalent CO₂ emission savings were calculated using the following emission factors. Electricity factors are specific to California electricity production.

Table 5: Equivalent CO₂ Emissions Factors

		<i>Source</i>
Electricity	0.724 lb. CO ₂ -e / kWh	U.S. Environmental Protection agency's 2007 eGRID data. ⁸
Natural Gas	11.7 lb. CO ₂ -e / Therm	Emission rates for natural gas combustion as reported by the U.S. Environmental Protection agency's GHG Equivalencies Calculator. ⁹

⁸ <https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>

⁹ <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

3 **Results**

Cost effective analysis including evaluating three efficiency packages and two PV performance packages was completed for all sixteen climate zones. Evaluations looked to identify cost effective Tier 1 and Tier 2 packages for both single family and multifamily prototypes at the CALGreen performance targets of 15% and 30%. When initial proposed packages were found to not be cost effective, multiple iterations were conducted to identify a cost effective package. In certain climates it was not feasible, and targets were subsequently relaxed to something more appropriate. In other climates no cost effective package could be identified. In almost every climate there was no cost effective way to achieve Tier 2 efficiency levels without the PV compliance credit, therefore all Tier 2 packages include PV. Because the PVCC is not available in climate zones 6 and 7, no Tier 2 packages were developed for those climates.

Since the results from this analysis are intended to support mandatory energy efficiency requirements, the authors intentionally selected proven cost-effective measures with wide market acceptance in typical residential construction. Achieving greater performance is feasible using advanced design strategies and measures.

3.1 *Single Family Results*

3.1.1 *Single Family Cost Effectiveness Analysis*

A comparison of cost effectiveness for each climate zone and five cases is presented in Figure 1. Table 6 and Table 7 provide the results in tabular form along with energy and greenhouse gas (GHG) savings for each efficiency and PV performance tier. Cost effectiveness results are presented for all three efficiency packages described previously (Envelope, Equipment, and PV Credit) as well as for the two PV performance packages (PV-Plus and TDV-Zero). A summary of measures included in each package is listed in Appendix B.1. The lifecycle benefit-to-cost ratio threshold of one is roughly equivalent to a simple payback of 18 years. Shaded rows in the tables reflect those cases which are not cost effective. While using high efficiency equipment is shown to result in the highest return on investment in many climates, it was necessary to find cost effective packages that do not require specification of equipment with efficiencies better than federally mandated values to avoid federal preemption prohibitions.

Tier 1 Envelope packages were found to be cost effective in climate zones 1 through 5 and 9 through 16. The Tier 1 threshold in climate zone 4 was reduced to 10% to meet the cost effectiveness criteria without installing equipment more efficient than federally mandated. No cost effective Tier 1 efficiency packages were identified in climate zones 6 through 8.

Table 7 presents results for the two PV performance packages including the PV capacity necessary to offset the specified TDV energy. The PV system capacity for the PV-Plus packages is sized based upon the values in Table 3 to provide approximately 80% of estimated annual kWh consumption. The required TDV-Zero PV capacity (as required to generate a TDV=0 compliance simulation result) ranges from 3.1 kW DC in the mild climates (CZ5 and 7) to 7.7 kW DC in hot climates (CZ15). In all cases the measures in these packages reflect those in the Tier 2 package, with the exception of climate zones 6 & 7 where they are based on the Tier 1 envelope package.

The PV-Plus cases demonstrate cost effectiveness with a benefit-to-cost ratio ranging from 1.08 to 1.49. Adding PV beyond the amount needed to offset electricity use reduces cost effectiveness in all cases. The Zero-TDV cases are cost effective in only four climate zones and benefit-cost ratios are consistently lower in all climates. This is impacted by the fact that the compliance model is based upon a home with natural gas space and water heating, thus when sizing PV to offset total house TDV, PV electricity generation is offsetting natural gas consumption. The customer is paid for excess electricity generation beyond what is consumed by the dwelling but only at the wholesale rate which is substantially lower than the retail rate.

Greenhouse gas (GHG) savings range from 4.1% to 12.7% for the envelope and equipment Tier 1 packages. Including the PV compliance credit increases GHG reductions to 39% on average. GHG reductions for the two PV packages average 50% and 77% for the PV-Plus and TDV-ZERO cases, respectively.

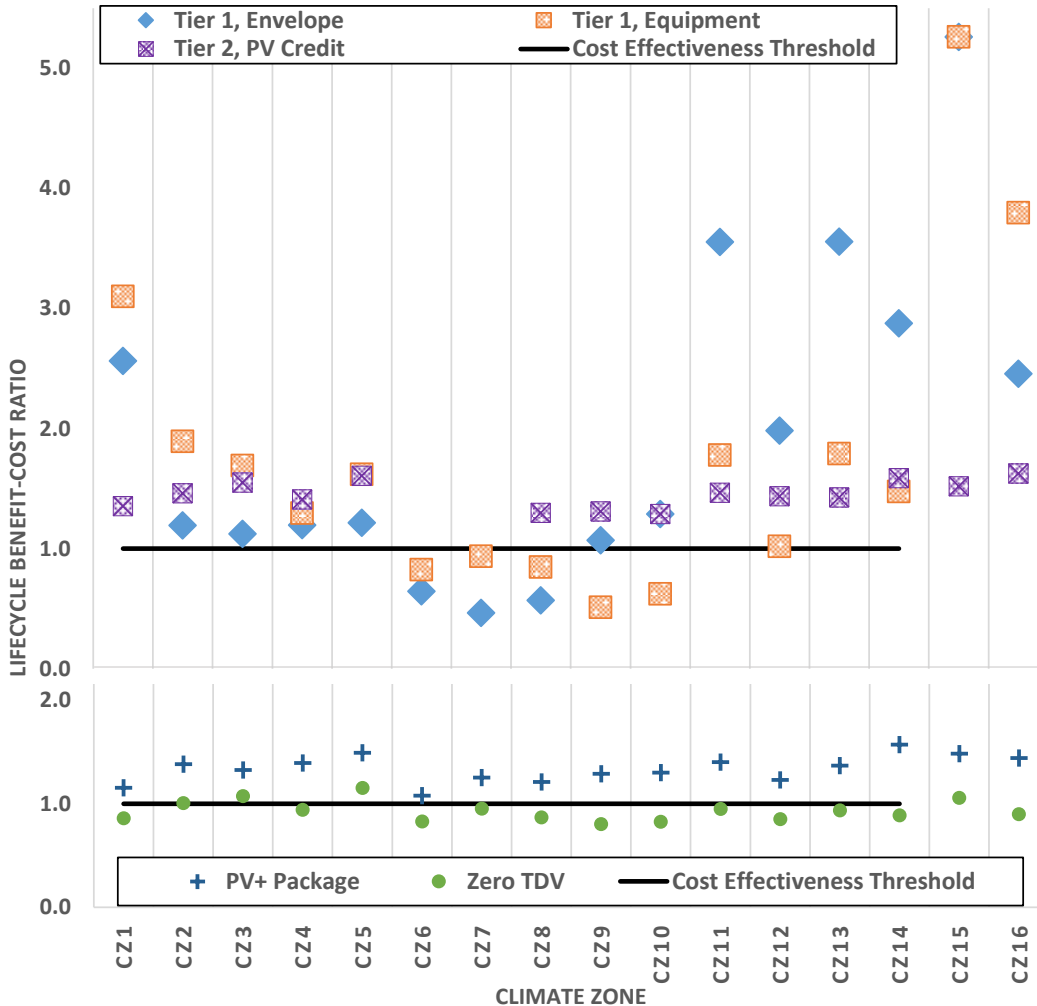


Figure 1: Single family cost effectiveness comparison

Table 6: Single Family Efficiency Package Cost Effectiveness Results¹

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings ²	Package Cost ³	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
Tier 1, Envelope Cases								
CZ1	16.1%	67	83.7	10.7%	\$1,043	\$146	7.2	2.56
CZ2	15.8%	146	49.1	8.2%	\$1,617	\$105	15.4	1.20
CZ3	15.5%	32	43.6	7.7%	\$1,043	\$64	16.3	1.13
CZ4	12.0%	114	18.8	4.1%	\$808	\$53	15.3	1.20
CZ5	15.2%	27	39.3	7.3%	\$812	\$54	15.1	1.22
CZ6	8.7%	20	17.1	3.6%	\$571	\$20	28.4	0.65
CZ7	7.0%	9	9.7	2.3%	\$571	\$15	39.3	0.47
CZ8	8.9%	37	10.2	2.6%	\$571	\$18	32.1	0.57
CZ9	17.2%	169	11.1	4.1%	\$808	\$47	17.2	1.07
CZ10	17.2%	213	12.9	4.7%	\$808	\$57	14.2	1.29
CZ11	16.9%	460	25.9	7.1%	\$808	\$156	5.2	3.55
CZ12	16.4%	222	24.2	5.4%	\$808	\$87	9.3	1.98
CZ13	17.4%	485	22.1	7.0%	\$808	\$157	5.2	3.56
CZ14	16.4%	441	24.4	6.9%	\$808	\$127	6.4	2.88
CZ15	15.2%	896	4.7	8.1%	\$728	\$209	3.5	5.26
CZ16	15.8%	296	80.4	9.8%	\$1,456	\$195	7.5	2.46
Tier 1, Equipment Cases								
CZ1	19.3%	47	101.7	12.7%	\$999	\$169	5.9	3.10
CZ2	16.8%	34	67.0	9.7%	\$999	\$103	9.7	1.89
CZ3	15.3%	23	45.4	8.0%	\$681	\$63	10.8	1.69
CZ4	17.0%	103	45.4	8.3%	\$1,156	\$82	14.2	1.30
CZ5	16.9%	22	46.0	8.4%	\$681	\$60	11.3	1.62
CZ6	15.5%	20	36.2	7.3%	\$842	\$38	22.2	0.83
CZ7	15.6%	9	25.7	5.8%	\$681	\$35	19.6	0.94
CZ8	17.4%	68	25.1	6.0%	\$838	\$39	21.6	0.85
CZ9	16.9%	159	12.2	4.2%	\$1,650	\$46	35.8	0.51
CZ10	16.6%	203	14.2	4.9%	\$1,650	\$56	29.4	0.62
CZ11	17.3%	473	26.0	7.2%	\$1,650	\$160	10.3	1.78
CZ12	16.0%	247	22.7	5.4%	\$1,650	\$92	18.0	1.02
CZ13	17.9%	507	21.5	7.1%	\$1,650	\$161	10.2	1.79
CZ14	17.1%	458	26.4	7.3%	\$1,650	\$133	12.4	1.48
CZ15	15.2%	896	4.7	8.1%	\$728	\$209	3.5	5.26
CZ16	17.6%	58	123.7	12.6%	\$999	\$207	4.8	3.80

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings ²	Package Cost ³	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
Tier 2, Cases with PV Credit								
CZ1	32.2%	2,947	111.8	35.7%	\$10,576	\$781	13.5	1.36
CZ2	31.4%	3,227	132.7	46.9%	\$10,158	\$809	12.6	1.46
CZ3	21.8%	3,190	40.1	40.3%	\$8,644	\$731	11.8	1.55
CZ4	30.4%	3,353	21.8	36.6%	\$8,801	\$677	13.0	1.41
CZ5	22.0%	3,392	35.6	43.7%	\$8,413	\$737	11.4	1.61
CZ6	N/A - No PV Credit							
CZ7	N/A - No PV Credit							
CZ8	36.4%	3,290	10.2	44.0%	\$8,721	\$617	14.1	1.30
CZ9	35.0%	3,333	13.2	41.5%	\$8,333	\$595	14.0	1.31
CZ10	32.2%	3,517	15.4	42.3%	\$8,721	\$612	14.2	1.29
CZ11	31.2%	3,698	35.8	34.7%	\$9,420	\$752	12.5	1.47
CZ12	32.4%	3,386	27.9	33.8%	\$8,721	\$684	12.8	1.44
CZ13	31.3%	3,584	25.4	33.2%	\$9,189	\$715	12.9	1.43
CZ14	30.9%	4,366	26.4	39.4%	\$9,265	\$801	11.6	1.59
CZ15	32.2%	4,610	4.7	39.0%	\$9,265	\$767	12.1	1.52
CZ16	31.5%	3,881	80.4	31.8%	\$9,606	\$852	11.3	1.63
¹ Shaded rows reflect those cases which are not cost effective. ² Based on CA electricity production and equivalent CO ₂ emission rates of 0.724 lbCO ₂ e / kWh & 11.7 lb-CO ₂ e / therm. ³ Includes 10% markup for builder profit and overhead.								

Table 7: Single Family PV Performance Package Cost Effectiveness Results¹

Climate Zone	Compliance Margin	PV Capacity (kW)	Elec Savings (kWh)	Gas Savings (therms)	GHG % Savings ²	Package Cost ³	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
PV-Plus Package									
CZ1	32.2%	3.0	4,178	111.8	45.0%	\$14,146	\$889	15.9	1.15
CZ2	31.4%	2.5	3,798	132.7	51.9%	\$11,575	\$872	13.3	1.38
CZ3	21.8%	2.6	4,082	40.1	49.7%	\$10,836	\$784	13.8	1.33
CZ4	30.4%	2.3	3,619	21.8	39.2%	\$9,441	\$716	13.2	1.39
CZ5	22.0%	2.3	3,838	35.6	48.6%	\$9,441	\$768	12.3	1.49
CZ6	10.8%	2.5	3,912	17.1	48.9%	\$10,294	\$604	17.0	1.08
CZ7	10.6%	2.2	3,556	9.7	51.5%	\$9,602	\$655	14.7	1.25
CZ8	36.4%	2.6	4,026	10.2	53.4%	\$10,525	\$693	15.2	1.21
CZ9	35.0%	2.5	4,092	13.2	50.3%	\$10,137	\$713	14.2	1.29
CZ10	32.2%	2.5	4,202	15.4	50.0%	\$10,351	\$733	14.1	1.30
CZ11	31.2%	3.5	5,728	35.8	51.1%	\$14,368	\$1,097	13.1	1.40
CZ12	32.4%	2.9	4,673	27.9	45.2%	\$11,903	\$799	14.9	1.23
CZ13	31.3%	3.7	5,863	25.4	52.1%	\$14,913	\$1,111	13.4	1.37
CZ14	30.9%	2.5	4,941	26.4	44.1%	\$10,507	\$900	11.7	1.57
CZ15	32.2%	4.6	8,600	4.7	72.2%	\$18,521	\$1,497	12.4	1.48
CZ16	31.5%	2.5	4,501	80.4	35.6%	\$11,022	\$866	12.7	1.44
Zero-TDV Package									
CZ1	32.2%	4.8	6,560	111.8	62.9%	\$21,054	\$987	21.3	0.86
CZ2	31.4%	4.0	6,200	132.7	72.9%	\$17,532	\$960	18.3	1.01
CZ3	21.8%	3.5	5,557	40.1	65.2%	\$14,465	\$845	17.1	1.07
CZ4	30.4%	3.9	6,252	21.8	65.3%	\$15,786	\$808	19.5	0.94
CZ5	22.0%	3.2	5,411	35.6	65.9%	\$13,070	\$821	15.9	1.15
CZ6	10.8%	3.5	5,530	17.1	68.3%	\$14,271	\$644	22.2	0.83
CZ7	10.6%	3.1	5,083	9.7	72.4%	\$13,221	\$686	19.3	0.95
CZ8	36.4%	3.7	5,821	10.2	76.3%	\$14,930	\$705	21.2	0.87
CZ9	35.0%	4.3	7,090	13.2	85.4%	\$17,258	\$756	22.8	0.80
CZ10	32.2%	4.3	7,103	15.4	82.5%	\$17,258	\$776	22.2	0.83
CZ11	31.2%	6.1	9,908	35.8	85.0%	\$24,555	\$1,269	19.3	0.95
CZ12	32.4%	5.1	8,094	27.9	75.4%	\$20,363	\$944	21.6	0.85
CZ13	31.3%	6.4	10,075	25.4	87.1%	\$25,488	\$1,299	19.6	0.94
CZ14	30.9%	5.5	10,295	26.4	88.0%	\$22,072	\$1,068	20.7	0.89
CZ15	32.2%	7.7	13,811	4.7	115.5%	\$30,610	\$1,762	17.4	1.06
CZ16	31.5%	5.2	9,147	80.4	64.2%	\$21,636	\$1,061	20.4	0.90
¹ Shaded rows reflect those cases which are not cost effective.									
² Based on CA electricity production and equivalent CO ₂ emission rates of 0.724 lbCO ₂ e / kWh & 11.7 lb-CO ₂ e / therm.									
³ Includes 10% markup for builder profit and overhead.									

3.1.2 Single Family Package Recommendations

Based on the single family cost effective analysis, two reach code packages were developed, an efficiency package and a PV package as described below. Table 8 and Table 9 summarize the measures used to cost effectively meet the performance targets for each package.

Tier 1 Efficiency only: Where cost effective packages were identified, the 15% compliance margin target, consistent with CALGreen Tier 1 were used. As stated earlier, a cost effective 15% package was not identified for climate zone 4, so a 10% compliance margin target was used. No cost effective efficiency only packages were identified for climate zones 6 through 8.

Table 8: Single Family Efficiency Only: Cost Effective Measures Summary

Climate Zone	Compliance Margin Target	QII	ACH50	Window U-value / SHGC	Door U-value	AH Fan W/cfm	HW Pipe Insul.
CZ1	15%	Y		.30/.50	0.20		Y
CZ2	15%	Y	3	.30/.23	0.20	0.30	Y
CZ3	15%	Y		.30/.50	0.20		Y
CZ4	10%	Y		.30/.23		0.30	
CZ5	15%	Y		.30/.50			Y
CZ6		No package					
CZ7		No package					
CZ8		No package					
CZ9	15%	Y		.30/.23		0.30	
CZ10	15%	Y		.30/.23		0.30	
CZ11	15%	Y		.30/.23		0.30	
CZ12	15%	Y		.30/.23		0.30	
CZ13	15%	Y		.30/.23		0.30	
CZ14	15%	Y		.30/.23		0.30	
CZ15	15%	Y				0.30	
CZ16	15%	Y	3	.30/.23	0.20	0.3	

PV-Plus: Cost effective packages with efficiency and PV were identified in all 16 climate zones, but the compliance margin targets were lowered to 20% for climates 3 and 5, and to 10% for 6 and 7. Table 9 summarizes the measures used in each climate zone to cost effectively meet the targets. It is assumed that the PV compliance credit can be used to meet all these targets, except in climate zones 6 and 7. It is also assumed that a PV system is installed per the methodology described in Table 3 and consistent with the CEC Solar PV Ordinance.

Table 9: Single Family PV-Plus: Cost Effective Measures Summary

Climate Zone	Compliance Margin Target	QII	ACH50	Window U-value / SHGC	Door U-value	HPA	AH Fan W/cfm	HW Pipe Insul.	PV Capacity (kW)
CZ1	30%	Y	3	.30/.50	0.20	Y		Y	3.0
CZ2	30%	Y		.30/.50	0.20	Y		Y	2.5
CZ3	20%	Y		.30/.50	0.20				2.6
CZ4	30%	Y		.30/.23					2.3
CZ5	20%	Y		.30/.50					2.3
CZ6	10%	Y					0.30		2.5
CZ7	10%	Y		.30/.23	0.20		0.30	Y	2.2
CZ8	30%	Y							2.6
CZ9	30%	Y							2.5
CZ10	30%	Y							2.5
CZ11	30%	Y		.30/.23	0.20				3.5
CZ12	30%	Y							2.9
CZ13	30%	Y		.30/.23					3.7
CZ14	30%	Y					0.30		2.5
CZ15	30%	Y					0.30		4.6
CZ16	30%	Y	3	.30/.23	0.20		0.30		2.5

3.2 Multifamily Results

It is generally more challenging to achieve equivalent savings targets 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. The PV credit is also much smaller because it is offsetting only high performance walls; high performance attic is not applied to the multifamily prescriptive design because ducts are already assumed to be within conditioned space. Shaded rows in the tables below indicate cases that don't meet the 15% target for Tier 1 or don't have feasible Tier 2 packages.

3.2.1 Multifamily Cost Effectiveness Analysis

A comparison of cost effectiveness for the multi-family prototype is presented in Figure 2. Table 10 and Table 11 provide the results in tabular form, along with energy and greenhouse gas savings for the efficiency and PV performance tiers, respectively. *All multifamily results are presented on a per dwelling unit basis.* Cost effectiveness results are presented for all of the three efficiency packages described previously (envelope, equipment, and PV compliance credit) as well as for the two PV performance packages (PV-Plus and TDV-Zero). A summary of measures included in each package is listed in Appendix B.2. The lifecycle benefit-to-cost ratio threshold of one is roughly equivalent to a simple payback of 18 years. Shaded rows in the tables reflect those cases which aren't cost effective. While using high efficiency equipment is shown to result in an improved return on investment in many climates, it was necessary to find cost effective packages that do not require specification of equipment with efficiencies better than federally mandated values. It can be noted that since rental rates are determined primarily by location, tenants may not experience increased rents due to the cost of efficiency measures. If this is the case, the tenants have no costs and only the benefit of lower energy utility costs.

Tier 1, Envelope packages were found to be cost effective in climate zones 1, and 10 through 16, although the threshold for climate zone 10 was lowered to 10% to meet the cost effectiveness criteria. QII alone was found to be cost effective in climate zone 2 but a cost effective 10% package requires using the PV

compliance credit. No cost effective Tier 1, Envelope efficiency packages were identified in climate zones 3 through 9 without the addition of high efficiency equipment or PV.

Table 11 summarizes the cost effectiveness of the PV performance packages. PV capacity required to meet the required TDV energy offset for each case is also included. The PV capacity for the PV-Plus packages are sized the same as for the single family analysis and based upon the values in Table 3. The required TDV-Zero PV capacity per apartment ranges from 1.9 kW DC in the mild climates to 3.7 kW DC in hot climates (CZ15). For the multifamily prototype 8-unit apartment building, this is equivalent to 15.2 to 29.6 kW for the building. In all cases the measures in these packages reflect those in the Tier 2 package, with the exception of climate zones 6 & 7 where they are based on the Tier 1 envelope package.

The PV-Plus cases demonstrate cost effectiveness with a benefit-to-cost ratio ranging from 1.01 to 1.66. Similar to the single family analysis, while PV is cost effective in offsetting electricity use, adding PV to meet a zero TDV design reduces cost effectiveness in all cases with only two climates having a value greater than 1.

Greenhouse gas (GHG) savings range from 2.2% to 8.6% for the envelope and equipment Tier 1 packages. Including the PV compliance credit increases GHG reductions to 34% on average. GHG reductions for the two PV packages average 49% and 78% for the PV-Plus and ZN-TDV cases, respectively.

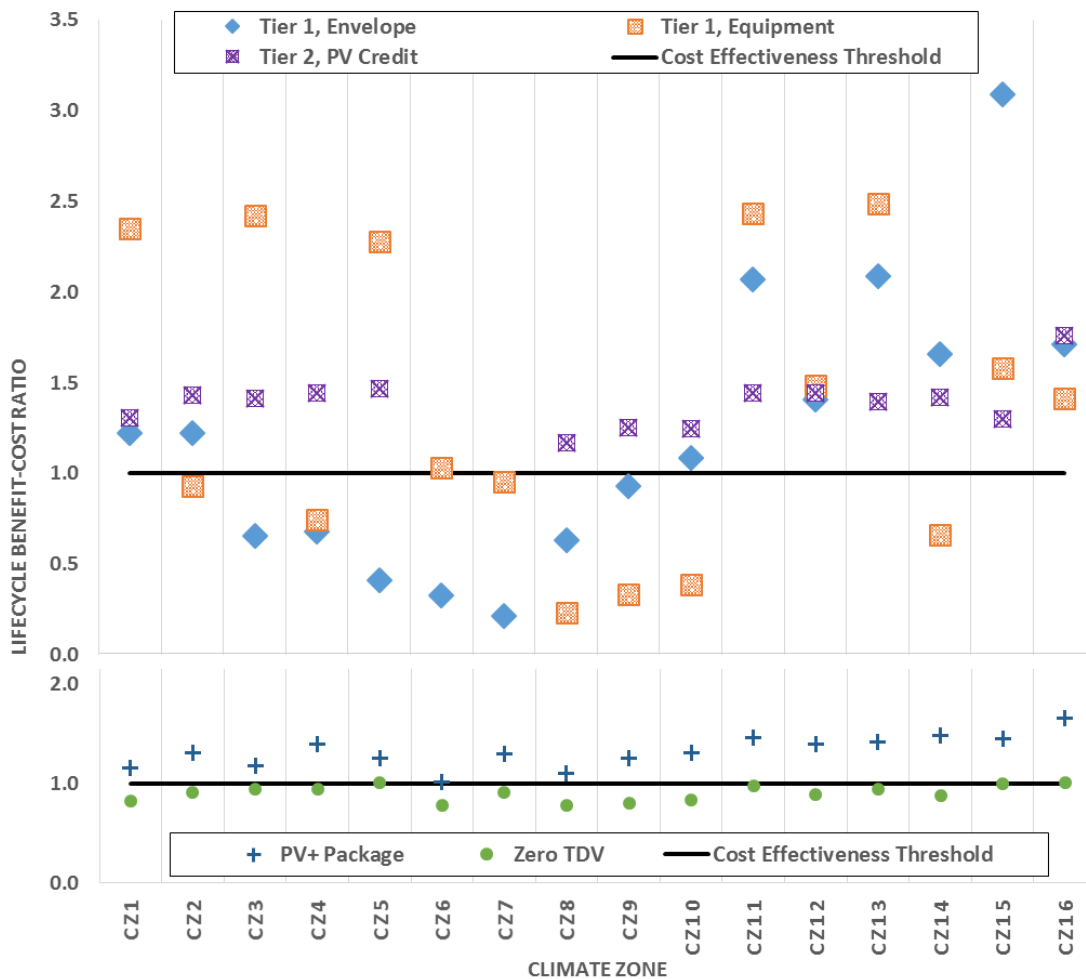


Figure 2: Multifamily cost effectiveness comparison

Table 10: Multifamily Efficiency Cost Effectiveness Results¹

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings ²	Package Cost ³	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
Tier 1, Envelope Cases								
CZ1	16.5%	31	28.0	8.0%	\$559	\$37	15.0	1.22
CZ2	4.8%	7	7.3	2.2%	\$146	\$10	15.0	1.22
CZ3	10.9%	-3	14.3	4.5%	\$444	\$16	28.1	0.65
CZ4	10.9%	45	4.6	2.3%	\$364	\$14	26.9	0.68
CZ5	10.2%	-4	13.3	4.2%	\$641	\$14	45.1	0.41
CZ6	11.7%	19	7.7	3.0%	\$559	\$10	55.7	0.33
CZ7	10.2%	10	4.3	1.7%	\$641	\$7	87.3	0.21
CZ8	10.5%	55	1.2	1.5%	\$282	\$10	29.0	0.63
CZ9	12.3%	79	2.0	2.2%	\$282	\$14	19.7	0.93
CZ10	10.1%	92	2.5	2.6%	\$282	\$17	16.9	1.08
CZ11	17.7%	186	13.2	6.5%	\$436	\$49	8.9	2.07
CZ12	17.1%	103	12.6	5.4%	\$436	\$33	13.1	1.41
CZ13	18.1%	200	11.3	6.3%	\$436	\$50	8.8	2.09
CZ14	17.8%	176	12.9	6.3%	\$436	\$39	11.1	1.66
CZ15	17.7%	426	0.6	6.8%	\$436	\$73	5.9	3.09
CZ16	16.3%	91	29.9	8.0%	\$559	\$52	10.7	1.71
Tier 1, Equipment Cases								
CZ1	16.7%	8	31.7	8.6%	\$290	\$37	7.8	2.35
CZ2	15.0%	7	27.3	8.0%	\$642	\$32	19.8	0.93
CZ3	12.4%	1	16.9	5.4%	\$146	\$19	7.6	2.42
CZ4	16.3%	11	25.5	8.0%	\$765	\$31	24.8	0.74
CZ5	11.8%	-3	16.6	5.3%	\$146	\$18	8.1	2.28
CZ6	12.1%	1	16.4	5.6%	\$269	\$15	17.8	1.03
CZ7	12.5%	-1	15.9	5.5%	\$379	\$20	19.3	0.95
CZ8	15.2%	83	1.2	2.1%	\$1,133	\$14	80.4	0.23
CZ9	15.7%	106	2.0	2.8%	\$1,029	\$19	55.4	0.33
CZ10	15.5%	124	2.5	3.2%	\$1,029	\$22	47.2	0.39
CZ11	16.5%	202	6.3	5.0%	\$333	\$44	7.5	2.43
CZ12	15.0%	109	6.1	3.6%	\$333	\$27	12.4	1.48
CZ13	15.4%	199	5.1	4.6%	\$311	\$42	7.4	2.48
CZ14	16.5%	201	6.1	4.9%	\$1,029	\$37	27.7	0.66
CZ15	20.4%	515	0.4	8.2%	\$1,029	\$89	11.6	1.58
CZ16	15.7%	86	29.8	7.9%	\$668	\$51	13.0	1.41

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings ²	Package Cost ³	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
Tier 2, Cases with PV Credit								
CZ1	21.0%	1,370	28.0	30.2%	\$4,085	\$291	14.1	1.31
CZ2	20.4%	1,608	17.2	33.7%	\$4,085	\$318	12.8	1.43
CZ3	15.3%	1,585	14.1	35.7%	\$4,085	\$315	13.0	1.41
CZ4	26.9%	1,654	13.6	35.6%	\$4,085	\$321	12.7	1.44
CZ5	12.4%	1,677	13.3	37.7%	\$4,085	\$326	12.5	1.46
CZ6	N/A - No PV credit							
CZ7	N/A - No PV credit							
CZ8	21.0%	1,622	5.7	35.3%	\$4,085	\$260	15.7	1.17
CZ9	26.8%	1,719	4.0	35.4%	\$3,963	\$270	14.7	1.25
CZ10	26.2%	1,734	4.9	35.2%	\$3,963	\$269	14.7	1.25
CZ11	26.5%	1,778	13.2	32.6%	\$3,963	\$311	12.7	1.44
CZ12	26.5%	1,673	12.6	32.8%	\$3,963	\$312	12.7	1.44
CZ13	27.3%	1,746	11.3	31.8%	\$3,963	\$301	13.2	1.39
CZ14	26.0%	1,973	12.9	36.0%	\$3,963	\$307	12.9	1.42
CZ15	25.4%	2,100	0.6	33.0%	\$3,963	\$281	14.1	1.30
CZ16	25.7%	1,734	42.4	33.8%	\$3,848	\$369	10.4	1.76
¹ Shaded rows reflect those cases which are not cost effective.								
² Based on CA electricity production and equivalent CO ₂ emission rates of 0.724 lbCO ₂ e / kWh & 11.7 lb-CO ₂ e / therm.								
³ Includes 10% markup for builder profit and overhead.								

Table 11: Multifamily PV Performance Cost Effectiveness Results¹

Climate Zone	Compliance Margin	PV Capacity (kW)	Elec Savings (kWh)	Gas Savings (therms)	GHG % Savings ²	Package Cost ³	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
PV-Plus Package									
CZ1	21.0%	1.6	2,172	28.0	43.5%	\$6,201	\$393	15.8	1.16
CZ2	20.4%	1.4	2,234	17.2	44.9%	\$5,496	\$393	14.0	1.31
CZ3	15.3%	1.5	2,374	14.1	51.2%	\$5,849	\$377	15.5	1.18
CZ4	26.9%	1.3	2,137	13.6	44.8%	\$5,143	\$391	13.1	1.40
CZ5	12.4%	1.4	2,350	13.3	51.1%	\$5,496	\$375	14.7	1.25
CZ6	11.7%	1.5	2,388	7.7	52.5%	\$5,849	\$322	18.1	1.01
CZ7	10.2%	1.3	2,139	4.3	48.0%	\$5,226	\$369	14.2	1.30
CZ8	21.0%	1.5	2,413	5.7	51.6%	\$5,849	\$350	16.7	1.10
CZ9	26.8%	1.4	2,372	4.0	48.4%	\$5,373	\$369	14.6	1.26
CZ10	26.2%	1.4	2,386	4.9	47.9%	\$5,373	\$383	14.0	1.31
CZ11	26.5%	1.7	2,893	13.2	50.8%	\$6,431	\$514	12.5	1.47
CZ12	26.5%	1.5	2,457	12.6	46.5%	\$5,726	\$437	13.1	1.40
CZ13	27.3%	1.8	2,982	11.3	52.2%	\$6,784	\$525	12.9	1.42
CZ14	26.0%	1.3	2,512	12.9	44.9%	\$5,021	\$406	12.4	1.49
CZ15	25.4%	2.1	3,940	0.6	61.8%	\$7,842	\$618	12.7	1.45
CZ16	25.7%	1.3	2,244	42.4	40.9%	\$4,906	\$444	11.1	1.66
Zero-TDV Package									
CZ1	21.0%	2.5	3,415	28.0	64.2%	\$9,476	\$424	22.3	0.82
CZ2	20.4%	2.3	3,674	17.2	70.7%	\$8,741	\$433	20.2	0.91
CZ3	15.3%	2.0	3,233	14.1	68.1%	\$7,767	\$400	19.4	0.94
CZ4	26.9%	2.2	3,587	13.6	72.4%	\$8,320	\$429	19.4	0.95
CZ5	12.4%	1.9	3,189	13.3	67.8%	\$7,254	\$399	18.2	1.01
CZ6	11.7%	2.1	3,356	8.0	72.7%	\$8,011	\$341	23.5	0.78
CZ7	10.2%	2.1	3,383	4.0	75.0%	\$7,903	\$394	20.0	0.92
CZ8	21.0%	2.4	3,768	5.7	79.6%	\$8,869	\$379	23.4	0.78
CZ9	26.8%	2.5	4,124	4.0	83.1%	\$9,154	\$403	22.7	0.81
CZ10	26.2%	2.5	4,115	4.9	81.5%	\$9,115	\$415	22.0	0.84
CZ11	26.5%	3.0	4,979	13.2	84.9%	\$11,052	\$586	18.9	0.97
CZ12	26.5%	2.8	4,509	12.6	82.3%	\$10,336	\$503	20.6	0.89
CZ13	27.3%	3.2	5,129	11.3	87.6%	\$11,681	\$603	19.4	0.95
CZ14	26.0%	2.7	5,056	12.9	86.8%	\$10,014	\$482	20.8	0.88
CZ15	25.4%	3.7	6,571	0.6	102.9%	\$13,389	\$726	18.4	0.99
CZ16	25.7%	2.6	4,398	42.4	71.0%	\$9,379	\$514	18.2	1.01
¹ Shaded rows reflect those cases which are not cost effective.									
² Based on CA electricity production and equivalent CO ₂ emission rates of 0.724 lbCO ₂ e / kWh & 11.7 lb-CO ₂ e / therm.									
³ Includes 10% markup for builder profit and overhead.									

3.2.2 Multifamily Package Recommendations

Based on the multifamily cost effective analysis, two reach code packages were developed, similar to the single family packages. Table 12 and Table 13 summarize the measures used to cost effectively meet the performance targets for each multifamily package.

Tier 1 Efficiency only: Where cost effective packages were identified, the 15% compliance margin target, consistent with CALGreen Tier 1 were used. As stated earlier, a cost effective 15% package was not identified for climate zone 10, so a 10% compliance margin target was used, and only QII was cost effective in climate zone 2. Additionally, no cost effective efficiency only packages were identified for climate zones 3 through 9.

Table 12: Multifamily Efficiency Only: Cost Effective Measures Summary

Climate Zone	Compliance Margin Target	QII	Window U-value / SHGC	Door U-value	AH Fan W/cfm	Refrigerant Charge	HW Comp. Dist.
CZ1	15%	Y	0.30/0.50	0.20	0.3		Y
CZ2	QII Only	Y					
CZ3		No package					
CZ4		No package					
CZ5		No package					
CZ6		No package					
CZ7		No package					
CZ8		No package					
CZ9		No package					
CZ10	10%	Y	0.30/0.23		0.3		
CZ11	15%	Y	0.30/0.23	0.20	0.3		
CZ12	15%	Y	0.30/0.23	0.20	0.3		
CZ13	15%	Y	0.30/0.23	0.20	0.3		
CZ14	15%	Y	0.30/0.23	0.20	0.3		
CZ15	15%	Y	0.30/0.23	0.20	0.3		
CZ16	15%	Y	0.30/0.23	0.20	0.3		Y

PV-Plus: Cost effective packages with efficiency and PV were identified in all 16 climate zones, but the compliance margin targets in all climates were lowered below 30% in all cases to be cost effective. Table 13 summarizes the compliance margin targets in each climate zone and the measures used to cost effectively meet the targets. As with the single family packages, with the exception of climate zones 6 and 7, it is assumed that the PV compliance credit can be used to meet these targets. It is also assumed that a PV system is installed per the methodology developed for the proposed Solar PV ordinance (Table 3).

Table 13: Multifamily PV-Plus: Cost Effective Measures Summary

Climate Zone	Compliance Margin Target	QII	Window U-value / SHGC	Door U-value	AH Fan W/cfm	HW Comp. Dist.	PV Capacity (kW)
CZ1	20%	Y	0.30/0.50	0.20	0.3	Y	1.6
CZ2	20%	Y	0.30/0.23	0.20	0.3	Y	1.4
CZ3	15%	Y	0.30/0.50	0.20	0.3	Y	1.5
CZ4	25%	Y	0.30/0.23	0.20	0.3	Y	1.3
CZ5	10%	Y	0.30/0.50	0.20	0.3	Y	1.4
CZ6	10%	Y	0.30/0.23	0.20			1.5
CZ7	10%	Y	0.30/0.23	0.20			1.3
CZ8	20%	Y	0.30/0.23	0.20	0.3	Y	1.5
CZ9	25%	Y	0.30/0.23	0.20	0.3		1.4
CZ10	25%	Y	0.30/0.23	0.20	0.3		1.4
CZ11	25%	Y	0.30/0.23	0.20	0.3		1.7
CZ12	25%	Y	0.30/0.23	0.20	0.3		1.5
CZ13	25%	Y	0.30/0.23	0.20	0.3		1.8
CZ14	25%	Y	0.30/0.23	0.20	0.3		1.3
CZ15	25%	Y	0.30/0.23	0.20	0.3		2.1
CZ16	25%	Y	0.30/0.23	0.20			1.3

4 Conclusions & Summary

This report evaluated the feasibility and cost effectiveness of “above code” ordinance performance tiers through the application of both efficiency measures and PV in all 16 California climate zones. For this analysis, PG&E rates were used for gas and electricity in climate zones 1 through 5, 11 through 13, and 16. SCE electricity rates and Southern California Gas rates were used for climate zones 6, 8 through 10, 14 and 15. SDG&E rates were used for electricity and gas for climate zone 7.

The following describes the recommended performance levels for the above-code ordinance packages. The original intent was to develop packages that align with the tiers as defined in the 2016 CALGreen code. Based on the analysis results, performance thresholds were reduced in some climates and eliminated altogether in other climates. Identifying cost effective efficiency (only) packages was particularly challenging in multifamily buildings. Table 14 and Table 15 summarize recommended cost effective ordinance criteria by climate zone for single family and multifamily buildings, respectively. Where cost effective packages exist, there is both a Tier 1 efficiency only package and the efficiency with PV (PV-Plus) package. The tables include the Title 24 compliance target needed to meet the criteria for each package. Tier 1 compliance targets are compliance margins for efficiency measures only and are designed to be met without using the PV Compliance Credit. The PV-Plus compliance targets are for projects that include PV. The efficiency targets are set higher, but assume that the PV compliance credit (PVCC) is used to meet the performance targets. The efficiency targets are set lower for climate zones 6 and 7 because projects built in these climate zones are not eligible to take the PVCC.

Following is a summary of the differences between the two packages defined in this analysis and the tiers defined in CALGreen.

Tier 1 Packages: CALGreen defines Tier 1 as showing a 15% or greater Title 24 compliance margin compared to the Standard Design. The intent of the Efficiency tier in this study was to find cost effective packages of measures that meet the CALGreen Tier 1 criteria without mandating the installation of PV or high efficiency equipment that exceed federal minimum levels. To encourage adoption of efficiency measures in preparation for the 2019 Title-24 code, the authors recommend that PV not be allowed as a means to meet the Tier 1 compliance requirements. Based on the lifecycle benefit-to-cost ratio metric applied in this analysis, cost effectiveness results for the single family and low-rise multifamily homes show that there exist multiple cost effective packages to meet Tier 1. There are several climates where the compliance margin targets are lowered to maintain the cost effectiveness criteria and other climates where no cost effective efficiency packages were identified.

PV-Plus Packages: CALGreen defines both Tier 2 and ZNE Tier performance levels. The ZNE Tier requires that the building meet the required efficiency targets as defined in Section A4.203.1.2.3 of 2016 CALGreen and size a PV system to offset 100% of the TDV energy of the building (achieve an Energy Design Rating of 0). The results of this work, based on dwellings with gas and electricity, found that sizing the PV system to meet the ZNE Tier criteria was generally not cost effective or in some limited cases, marginally cost effective. Instead a PV and efficiency package (PV-Plus) was developed that limited the size of the PV system to no larger than the annual estimated electricity use of the building and combine it with efficiency measures that are cost effective in all climate zones. Lifecycle benefit-to-cost ratio for the PV-Plus cases for both the single family and multifamily prototypes are all above one. In cases where PV capacity in the PV-Plus package is less than the minimum to meet the PV compliance credit, it's recommended that jurisdictions allow the smaller PV capacity be installed and still qualify for the PVCC to avoid sizing the PV systems larger than the estimated electricity use.

Table 14: Single Family Reach Code Package Recommendations

Packages	Climate Zones	T-24 Compliance Target	PVCC Allowed	PV
Tier 1 Efficiency Only Package	1-3, 5, 9-16	15%	No	n/a
	4	10%	No	n/a
PV-Plus Package	1,2,4, 8-16	30%	Yes	Yes
	3,5	20%	Yes	Yes
	6-7	10%	n/a	Yes

Table 15: Multifamily Reach Code Package Recommendations

Packages	Climate Zones	T-24 Compliance Target	PVCC Allowed	PV
Tier 1 Efficiency Only Package	1, 11-16	15%	No	n/a
	10	10%	No	n/a
	2	QII	No	n/a
PV-Plus Package	4, 9-16	25%	Yes	Yes
	1-2, 8	20%	Yes	Yes
	3	15%	Yes	Yes
	5	10%	Yes	Yes
	6-7	10%	n/a	Yes

Consistent with CALGreen, a pre-requisite for all packages includes HERS verification of Quality Insulation Installation (QII).

The recommended packages do not include a TDV-Zero option because these packages were generally not found to be cost effective. Lifecycle benefit-to-cost ratios for the single family TDV-Zero packages are 0.78 to 1.07. Limited cost effectiveness is largely a result of oversizing the PV systems relative to the house electricity load. With mixed fuel homes, PV electricity generation offsets natural gas consumption when sizing relative to zero TDV. The consumer is compensated by the utility for electricity generation in excess of annual consumption, but only at the wholesale rate which is substantially lower than the retail rate. Consideration of dwellings without gas was not in the scope of this study.

In conclusion, this report has identified cost effective options to meet above-code performance levels for dwellings using natural gas and electricity which can be adopted by cities and counties within investor-owned utility territories across California. Including PV to the level of offsetting electricity loads was found to be cost effective in all sixteen climate zones evaluated as summarized above.

5 References

CEC. 2016a. 2016 Alternative Calculation Method Approval Manual. CEC-400-2015-039-CMF. June 2015. California Energy Commission. <http://www.energy.ca.gov/2015publications/CEC-400-2015-039/CEC-400-2015-039-CMF.pdf>

CEC. 2016b. 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. CEC-400-2015-037-CMF. June 2015. California Energy Commission.

<http://www.energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf>

CEC. 2016c. 2016 Reference Appendices. CEC-400-2015-038-CMF. June 2015. California Energy Commission. <http://www.energy.ca.gov/2015publications/CEC-400-2015-038/CEC-400-2015-038-CMF.pdf>

CEC. 2016d. 2016 Residential Alternative Calculation Method Reference Manual. CEC-400-2015-024-CMF-REV. June 2017. California Energy Commission.

<http://www.energy.ca.gov/2015publications/CEC-400-2015-024/CEC-400-2015-024-CMF-REV.pdf>

Horii, B., E. Cutter, N. Kapur, J. Arent, and D. Conotyannis. 2014. "Time Dependent Valuation of Energy for Developing Building Energy Efficiency Standards."

http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09_workshop/2017_TDV_Documents/

Appendix A – Prescriptive Package

The following presents the residential prescriptive package as printed in the 2016 Building Energy Efficiency Standards (CEC, 2016b).

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

						C															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Roofs/ Ceilings	Option A (meets §150.1(c)(9A))	Continuous Insulation Above Roof Rafter	Roofing Type	No Air Space ¹	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8	R 8	
				With Air Space ²	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	
			Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	
			Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	
		Option B (meets §150.1(c)(9A))	Below Roof Deck Insulation	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18
				With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	
			Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	
			Radiant Barrier		NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR	
		Option C (meets	Ceiling Insulation		R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	
			Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Walls	Above Grade	Framed ⁴	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.065	U 0.065	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051
			Mass Wall Interior ⁵	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.059 R 17
			Mass Wall Exterior ⁶	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.1025 R 8.0	U 0.125 R 8.0	U 0.070 R 13
		Below Grade	Below Grade Interior ⁷	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.066 R 15
			Below Grade Exterior	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.100 R 10	U 0.100 R 10	U 0.053 R 19
	Floors	Slab Perimeter		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0
		Raised		U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19
		Concrete Raised		U 0.092 R 8.0	U 0.092 R 8.0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0
Building Envelope	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
		Steep Sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
Building Envelope	Fenestration	Maximum U-factor		0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
		Maximum SHGC		NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum West Facing Area		NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

				Climate Zone																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
HVAC SYSTEM	Space Heating ¹¹	Electric-Resistance Allowed		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	
		If gas, AFUE		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
		If Heat Pump, HSPF ⁹		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
	Space cooling	SEER		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
		Refrigerant Charge Verification or Fault Indicator Display		NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	
		Whole House Fan ¹⁰		NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	NR	
	Central System Air Handlers	Central Fan Integrated Ventilation System Fan Efficacy		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	
	Ducts ¹²	Roof/Ceiling Options A & B	Duct Insulation	R-8	R-8	R-6	R-8	R-6	R-6	R-6	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	
			§150.1(c)9A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
		Roof/Ceiling	Duct Insulation	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6
			§150.1(c)9B	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
Water Heating	All Buildings			System Shall meet Section 150.1(c)8																

Footnote requirements to TABLE 150.1-A:¹⁰

1. Install the specified R-value with no air space present between the roofing and the roof deck.
2. Install the specified R-value with an air space present between the roofing and the roof deck. Such as standard installation of concrete or clay tile.
3. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members.
4. Assembly U-factors can be met with cavity insulation alone or with continuous insulation alone, or with both cavity and continuous insulation that results in an assembly U-factor equal to or less than the U-factor shown. Use Reference Joint Appendices JA4 Table 4.3.1, 4.3.1(a), or Table 4.3.4 to determine alternative insulation products to meet the required maximum U-factor.
5. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft². "Interior" denotes insulation installed on the inside surface of the wall.
6. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft². "Exterior" denotes insulation installed on the exterior surface of the wall.
7. Below grade "interior" denotes insulation installed on the inside surface of the wall.
8. Below grade "exterior" denotes insulation installed on the outside surface of the wall.
9. HSPF means "heating seasonal performance factor."
10. When whole house fans are required (REQ), only those whole house fans that are listed in the Appliance Efficiency Directory may be installed. Compliance requires installation of one or more WHFs whose total airflow CFM is capable of meeting or exceeding a minimum 1.5 cfm/square foot of conditioned floor area as specified by Section 150.1(c)12.
11. A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kilowatts or 7,000 Btu/hr and is controlled by a timelimiting device not exceeding 30 minutes.
12. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.

¹⁰ Single family buildings are modeled with Option B and multifamily buildings are modeled with Option C.

Appendix B.1 – Single Family Package Summaries

Table 16: Single Family Tier Packages

Climate Zone	QII	ACH50	Window U-value / SHGC	Door U-value	HPA	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	DHW EF	HW Pipe Insul.	PV Credit Size (kW)	T-24 Comp. Margin
Tier 1, Envelope Cases												
CZ1	Y		.30/.50	0.20						Y		16.1%
CZ2	Y	3	.30/.23	0.20				0.30		Y		15.8%
CZ3	Y		.30/.50	0.20						Y		15.5%
CZ4	Y		.30/.23					0.30				12.0%
CZ5	Y		.30/.50							Y		15.2%
CZ6	Y											8.7%
CZ7	Y											7.0%
CZ8	Y											8.9%
CZ9	Y		.30/.23					0.30				17.2%
CZ10	Y		.30/.23					0.30				17.2%
CZ11	Y		.30/.23					0.30				16.9%
CZ12	Y		.30/.23					0.30				16.4%
CZ13	Y		.30/.23					0.30				17.4%
CZ14	Y		.30/.23					0.30				16.4%
CZ15	Y							0.30				15.2%
CZ16	Y	3	.30/.23	0.20				0.30				15.8%
Tier 1, Equipment Cases												
CZ1	Y					0.92						19.3%
CZ2	Y					0.92						16.8%
CZ3	Y								0.94			15.3%
CZ4	Y					0.92		0.30				17.0%
CZ5	Y								0.94			16.9%
CZ6	Y								0.94	Y		15.5%
CZ7	Y								0.94			15.6%
CZ8	Y							0.30	0.94			17.4%
CZ9	Y						15/12.5	0.30				16.9%
CZ10	Y						15/12.5	0.30				16.6%
CZ11	Y						15/12.5	0.30				17.3%
CZ12	Y						15/12.5	0.30				16.0%
CZ13	Y						15/12.5	0.30				17.9%
CZ14	Y						15/12.5	0.30				17.1%
CZ15	Y							0.30				15.2%
CZ16	Y					0.92						17.6%

Climate Zone	QII	ACH50	Window U-value / SHGC	Door U-value	HPA	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	DHW EF	HW Pipe Insul.	PV Credit Size (kW)	T-24 Comp. Margin
Tier 2, Cases with PV Credit												
CZ1	Y	3	.30/.50	0.20	Y					Y	2.1	32.2%
CZ2	Y		.30/.50	0.20	Y					Y	2.1	31.4%
CZ3	Y		.30/.50	0.20							2.0	21.8%
CZ4	Y		.30/.23								2.1	30.4%
CZ5	Y		.30/.50								2.0	22.0%
CZ6						N/A – No PV Credit						
CZ7						N/A – No PV Credit						
CZ8	Y										2.1	36.4%
CZ9	Y										2.0	35.0%
CZ10	Y										2.1	32.2%
CZ11	Y		.30/.23	0.20							2.2	31.2%
CZ12	Y										2.1	32.4%
CZ13	Y		.30/.23								2.2	31.3%
CZ14	Y							0.30			2.2	30.9%
CZ15	Y							0.30			2.2	32.2%
CZ16	Y	3	.30/.23	0.20				0.30			2.1	31.5%

Appendix B.2 – Multifamily Package Summaries

Table 17: Multifamily Tier 1 Packages

Climate Zone	QII	Window U-value / SHGC	Door U-value	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	Refrigerant Charge	DHW EF	HW Comp. Dist.	PV Credit Size (kW)	T-24 Comp. Margin
Tier 1, Envelope Cases											
CZ1	Y	0.30/0.50	0.20			0.3			Y		16.5%
CZ2	Y										4.8%
CZ3	Y	0.30/0.50	0.20						Y		10.9%
CZ4	Y	0.30/0.23				0.3	Y				10.9%
CZ5	Y	0.30/0.50	0.20			0.3	Y		Y		10.2%
CZ6	Y	0.30/0.23	0.20			0.3			Y		11.7%
CZ7	Y	0.30/0.23	0.20			0.3	Y		Y		10.2%
CZ8	Y	0.30/0.23				0.3					10.5%
CZ9	Y	0.30/0.23				0.3					12.3%
CZ10	Y	0.30/0.23				0.3					10.1%
CZ11	Y	0.30/0.23	0.20			0.3					17.7%
CZ12	Y	0.30/0.23	0.20			0.3					17.1%
CZ13	Y	0.30/0.23	0.20			0.3					18.1%
CZ14	Y	0.30/0.23	0.20			0.3					17.8%
CZ15	Y	0.30/0.23	0.20			0.3					17.7%
CZ16	Y	0.30/0.23	0.20			0.3			Y		16.3%
Tier 1, Equipment Cases											
CZ1	Y	0.30/0.50						94	Y		16.7%
CZ2	Y			92				96			15.0%
CZ3	Y							94			12.4%
CZ4	Y			92				96	Y		16.3%
CZ5	Y							94			11.8%
CZ6	Y							94	Y		12.1%
CZ7	Y							96	Y		12.5%
CZ8	Y	0.30/0.23			16/13	0.3	Y				15.2%
CZ9	Y				16/13	0.3					15.7%
CZ10	Y				16/13	0.3					15.5%
CZ11	Y	0.30/0.23			15/12.5	0.3					16.5%
CZ12	Y	0.30/0.23			15/12.5	0.3					15.0%
CZ13	Y				15/12.5	0.3					15.4%
CZ14	Y				16/13	0.3					16.5%
CZ15	Y				16/13	0.3					20.4%
CZ16	Y	0.30/0.23		92		0.3					15.7%

Climate Zone	QII	Window U-value / SHGC	Door U-value	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	Refrigerant Charge	DHW EF	HW Comp. Dist.	PV Credit Size (kW)	T-24 Comp. Margin
Tier 2, Cases with PV Credit											
CZ1	Y	0.30/0.50	0.20			0.3			Y	1.0	21.0%
CZ2	Y	0.30/0.23	0.20			0.3			Y	1.0	20.4%
CZ3	Y	0.30/0.50	0.20			0.3			Y	1.0	15.3%
CZ4	Y	0.30/0.23	0.20			0.3			Y	1.0	26.9%
CZ5	Y	0.30/0.50	0.20			0.3			Y	1.0	12.4%
CZ6					N/A – No PV Credit						
CZ7					N/A – No PV Credit						
CZ8	Y	0.30/0.23	0.20			0.3			Y	1.0	21.0%
CZ9	Y	0.30/0.23	0.20			0.3				1.0	26.8%
CZ10	Y	0.30/0.23	0.20			0.3				1.0	26.2%
CZ11	Y	0.30/0.23	0.20			0.3				1.0	26.5%
CZ12	Y	0.30/0.23	0.20			0.3				1.0	26.5%
CZ13	Y	0.30/0.23	0.20			0.3				1.0	27.3%
CZ14	Y	0.30/0.23	0.20			0.3				1.0	26.0%
CZ15	Y	0.30/0.23	0.20			0.3				1.0	25.4%
CZ16	Y	0.30/0.23	0.20							1.0	25.7%

Appendix C - Utility Rate Tariffs

Following are the PG&E electricity, both standard and time-of-use, and natural gas tariffs applied in this study. The PG&E monthly gas rate in \$/therm was applied on a monthly basis for the 12-month period ending March 2016.



Pacific Gas and Electric Company
San Francisco, California
U 39

Cancelling

Revised
Revised

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

36706-E
36470-E

ELECTRIC SCHEDULE E-1 RESIDENTIAL SERVICES

Sheet 1

APPLICABILITY: This schedule is applicable to single-phase and polyphase residential service in single-family dwellings and in flats and apartments separately metered by PG&E; to single-phase and polyphase service in common areas in a multifamily complex (see Special Condition 8); and to all single-phase and polyphase farm service on the premises operated by the person whose residence is supplied through the same meter.

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

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

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

Customers receiving a medical baseline allowance shall pay for all usage in excess of 200 percent of baseline at a rate \$0.04000 per kWh less than the applicable rate for usage in excess of 200 percent of baseline. No portion of the rates paid by customers that receive a Medical Baseline allowance shall be used to pay the DWR Bond charge. For these customers, the Conservation Incentive Adjustment is calculated residually based on the total rate less the sum of: Transmission, Transmission Rate Adjustments, Reliability Services, Distribution, Generation, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges (CTC), New System Generation Charges,¹ and Energy Cost Recovery Amount. Customers receiving a medical baseline allowance shall also receive a 50 percent discount on the delivery minimum bill amount shown below.

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

TOTAL RATES

Total Energy Rates (\$ per kWh)	
Baseline Usage	\$0.18212
101% - 130% of Baseline	\$0.24090 (I)
131% - 200% of Baseline	\$0.24090 (R)
201% - 300% of Baseline	\$0.39999 (I)
Over 300% of Baseline	\$0.39999 (I)
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)	(\$28.14)

¹ Per Decision 11-12-031, New System Generation Charges are effective 1/1/2012.

(Continued)

Advice Letter No: 4810-E-A
Decision No. 15-07-001 and E-4782

Issued by
Steven Malnight
Senior Vice President
Regulatory Affairs

Date Filed May 31, 2016
Effective June 1, 2016
Resolution No. _____

1C8



Pacific Gas and Electric Company
San Francisco, California
U 39

Cancelling

Revised
Revised

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

36713-E
36500-E

ELECTRIC SCHEDULE E-TOU
RESIDENTIAL TIME-OF-USE SERVICE

Sheet 2

RATES
(Cont'd.):

OPTION A TOTAL RATES

Total Energy Rates (\$ per kWh)	PEAK		OFF-PEAK	
<i>Summer</i>				
Total Usage	\$0.40327	(I)	\$0.32769	(I)
Baseline Credit (Applied to Baseline Usage Only)	(\$0.11709)	(R)	(\$0.11709)	(R)
<i>Winter</i>				
Total Usage	\$0.28530	(I)	\$0.27100	(I)
Baseline Credit (Applied to Baseline Usage Only)	(\$0.11709)	(R)	(\$0.11709)	(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)	(\$28.14)			

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 Charges¹ based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.*

¹ Per Decision 11-12-031, New System Generation Charges are effective 1/1/2012.

* This same assignment of revenues applies to direct access and community choice aggregation customers.

(Continued)

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Steven Malnight
Senior Vice President
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2C9



Pacific Gas and Electric Company
San Francisco, California
U 39

Cancelling

Revised
Revised

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

32682-G
32620-G

GAS SCHEDULE G-1 RESIDENTIAL SERVICE

Sheet 1

APPLICABILITY: This rate schedule* 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.

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:

<u>Minimum Transportation Charge:**</u>		<u>Per Day</u>	
		\$0.09863	
		<u>Per Therm</u>	
<u>Procurement:</u>	<u>Baseline</u>		<u>Excess</u>
	\$0.20960 (R)		\$0.20960 (R)
<u>Transportation Charge:</u>	<u>\$0.81592</u>		<u>\$1.30547</u>
Total:	\$1.02552 (R)		\$1.51507 (R)

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.

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

BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)		
Baseline Territories***	Summer Effective Apr. 1, 2016	Winter Effective Nov. 1, 2015
P	0.46	2.15
Q	0.69	1.98
R	0.46	1.79
S	0.46	1.92
T	0.69	1.79
V	0.69	1.79
W	0.46	1.69
X	0.59	1.98
Y	0.85	2.55

* PG&E's gas tariffs are available online at www.pge.com.

** The Minimum Transportation charge does not apply to submetered tenants of master-metered customers served under gas rate Schedules GS and GT.

*** The applicable baseline territory is described in Preliminary Statement, Part A.

(Continued)

Advice Letter No: 3715-G
Decision No. 97-10-065 & 98-07-025

Issued by
Steven Malnight
Senior Vice President
Regulatory Affairs

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Resolution No. _____

1C6

Following are the SCE electricity tariffs, both standard and time-of-use, and SoCalGas natural gas tariffs applied in this study.



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

Revised Cal. PUC Sheet No. 59026-E
Cancelling Revised Cal. PUC Sheet No. 58237-E

Schedule D		Sheet 2	
DOMESTIC SERVICE			
(Continued)			
RATES			
	Delivery Service Total ¹	Generation ²	
		UG ³	DWREC ⁴
Energy Charge- \$/kWh/Meter/Day			
Baseline Service			
Summer	0.06799 (I)	0.06919 (I)	(0.00022)
Winter	0.06799 (I)	0.06919 (I)	(0.00022)
Nonbaseline Service*			
101% - 200% of Baseline - Summer	0.15997 (I)	0.06919 (I)	(0.00022)
Winter	0.15997 (I)	0.06919 (I)	(0.00022)
Over 200% of Baseline - Summer	0.22305 (R)	0.06919 (I)	(0.00022)
Winter	0.22305 (R)	0.06919 (I)	(0.00022)
Basic Charge - \$/Meter/Day			
Single-Family Accommodation	0.031		
Multi-Family Accommodation	0.024		
Minimum Charge** - \$/Meter/Day			
Single-Family Accommodation	0.329		
Multi-Family Accommodation	0.329		
Minimum Charge (Medical Baseline)** - \$/Meter/Day			
Single-Family Accommodation	0.164		
Multi-Family Accommodation	0.164		
California Climate Credit ⁴	(35.00)		
Peak Time Rebate - \$/kWh		(0.75)	
Peak Time Rebate enabling technology - \$/kWh		(1.25)	

* Nonbaseline Service includes all kWh in excess of applicable Baseline allocations as described in Preliminary Statement, Part H, Baseline Service.

** The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.

*** The ongoing Competition Transition Charge (CTC) of \$(0.00015) per kWh is recovered in the UG component of Generation.

1. Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.

2. Generation = The Generation rates are applicable only to Bundled Service Customers.

3. DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.

4. Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 3401-E
Decision 16-03-030

2011

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R. O. Nichols
Senior Vice President

(To be inserted by Cal. PUC)

Date Filed May 2, 2016
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Resolution



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

Revised Cal. PUC Sheet No. 59059-E
Cancelling Revised Cal. PUC Sheet No. 58249-E

Schedule TOU-D-T
TIME-OF-USE TIERED DOMESTIC

Sheet 2

(Continued)

RATES



	Delivery Service Total ¹	Generation ²	
		UG***	DWREC ⁴
Energy Charge - \$/kWh/Meter/Day			
Summer Season - On-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.21660 (R)	(0.00022)
Level II (More than 130% of Baseline)	0.16352 (R)	0.21660 (R)	(0.00022)
Summer Season - Off-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.05311 (I)	(0.00022)
Level II (More than 130% of Baseline)	0.16352 (R)	0.05311 (I)	(0.00022)
Winter Season - On-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.09660 (R)	(0.00022)
Level II (More than 130% of Baseline)	0.16352 (R)	0.09660 (R)	(0.00022)
Winter Season - Off-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.04749 (I)	(0.00022)
Level II (More than 130% of Baseline)	0.16352 (R)	0.04749 (I)	(0.00022)
Basic Charge - \$/Meter/Day			
Single-Family Accommodation	0.031		
Multi-Family Accommodation	0.024		
Minimum Charge* - \$/Meter/Day			
Single-Family Accommodation	0.329		
Multi-Family Accommodation	0.329		
Minimum Charge (Medical Baseline)** - \$/Meter/Day			
Single-Family Accommodation	0.164		
Multi-Family Accommodation	0.164		
California Climate Credit ⁴	(36.00)		
California Alternate Rates for Energy Discount - %	100.00*		
Peak Time Rebate - \$/kWh		(0.75)	
Peak Time Rebate enabling technology - \$/kWh		(1.25)	

* The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.

** Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.

*** The ongoing Competition Transition Charge (CTC) of \$(0.00015) per kWh is recovered in the UG component of Generation.

1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.

2 Generation = The Gen rates are applicable only to Bundled Service Customers.

3 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.

4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 3401-E
Decision 16-03-030

2C19

Issued by

R. O. Nichols
Senior Vice President

(To be inserted by Cal. PUC)

Date Filed May 2, 2016
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Resolution _____

SOUTHERN CALIFORNIA GAS COMPANY Revised CAL P.U.C. SHEET NO. 52782-G
LOS ANGELES, CALIFORNIA CANCELING Revised CAL P.U.C. SHEET NO. 52751-G

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

Sheet 1

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

	<u>GR</u>	<u>GR-C</u>	<u>GT-R</u>
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/}	34.536¢	34.536¢	N/A	I
Transmission Charge: ^{3/}	56.280¢	56.280¢	55.758¢	I
Total Baseline Charge:	90.816¢	90.816¢	55.758¢	

Non-Baseline Rate, per therm (usage in excess of baseline usage):

Procurement Charge: ^{2/}	34.536¢	34.536¢	N/A	I
Transmission Charge: ^{3/}	82.280¢	82.280¢	81.758¢	I
Total Non-Baseline Charge:	116.816¢	116.816¢	81.758¢	

^{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)

ADVICE LETTER NO. 4989

DECISION NO.

106

ISSUED BY

Dan Skopec

Vice President

Regulatory Affairs


(TO BE INSERTED BY CAL. PUC)

DATE FILED Jul 7, 2016

EFFECTIVE Jul 10, 2016

RESOLUTION NO. G-3351

Following are the SDG&E electricity, both standard and time-of-use, and natural gas tariffs applied in this study.



San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 27650-E

Canceling Revised Cal. P.U.C. Sheet No. 26948-E

Sheet 1

SCHEDULE DR

RESIDENTIAL SERVICE

(Includes Rates for DR-LI)

APPLICABILITY

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

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

Customers on this schedule may also qualify for a semi-annual California Climate Credit \$(17.44) per Schedule GHG-ARR.

TERRITORY

Within the entire territory served by the Utility.

RATES

Total Rates:

Description - DR Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
Summer:				
Baseline Energy (\$/kWh)	0.05480 I	0.00539	0.12965	0.18984 I
Above 130% of Baseline	0.25645 R	0.00539	0.12965	0.39149 R
Winter:				
Baseline Energy (\$/kWh)	0.10256 I	0.00539	0.06604	0.17399 I
Above 130% of Baseline	0.26737 R	0.00539	0.06604	0.33880 R
Minimum Bill (\$/day)	0.329			0.329

Description -DR-LI Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
Summer - CARE Rates:				
Baseline Energy (\$/kWh)	0.05225 I	0.00000	0.12965	0.18190 I
Above 130% of Baseline	0.25390 R	0.00000	0.12965	0.38355 R
Winter - CARE Rates:				
Baseline Energy (\$/kWh)	0.10001 I	0.00000	0.06604	0.16605 I
Above 130% of Baseline	0.26482 R	0.00000	0.06604	0.33086 R
Minimum Bill (\$/day)	0.164			0.164

(Continued)

1C10

Advice Ltr. No. 2861-E-A

Decision No. 15-07-001

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Date Filed Jun 29, 2016

Effective Jul 1, 2016

Resolution No. E-4787



San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 26962-E
Canceling Revised Cal. P.U.C. Sheet No. 26908-E

SCHEDULE DR-SES

Sheet 1

DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH A SOLAR ENERGY SYSTEM

APPLICABILITY

Service under this schedule is available on a voluntary basis for individually metered residential customers with Solar Energy Systems. Service is limited to individually metered residential customers with a Solar Energy System with domestic service for lighting, heating, cooking, water heating, and power, or combination thereof, in single family dwellings and flats. Qualifying California Alternative Rates for Energy (CARE) customers are eligible for service on this schedule, as further described under Special Condition 8 of this schedule.

Customers on this schedule may also qualify for a semi-annual California Climate Credit \$(17.44) per Schedule GHG-ARR.

TERRITORY

Within the entire territory served by the Utility.

RATES

Total Rates:

Description - DR-SES Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
Energy Charges (\$/kWh)				
On-Peak - Summer	0.12635 I	0.00539 I	0.33023 R	0.46397 R
Semi-Peak - Summer	0.12635 I	0.00539 I	0.09530 R	0.22904 R
Off-Peak - Summer	0.12635 I	0.00539 I	0.07332 R	0.20706 R
Semi-Peak - Winter	0.12635 I	0.00539 I	0.06159 R	0.21533 R
Off-Peak - Winter	0.12635 I	0.00539 I	0.06826 R	0.20200 R
Minimum Bill (\$/day)	0.329			0.329

- (1) Total Rates consist of UDC, Schedule DWR-BC (Department of Water Resources Bond Charge), and Schedule EECC (Electric Energy Commodity Cost) rates, with the EECC rates reflecting a DWR Credit of \$(0.00021) that customers receive on their monthly bills.
- (2) Total Rates presented are for customers that receive commodity supply and delivery service from Utility. Differences in total rates paid by Direct Access (DA) and Community Choice Aggregation (CCA) customers are identified in Schedule DA-CRS and CCA-CRS, respectively.
- (3) DWR-BC charges do not apply to CARE or Medical Baseline customers.

UDC Rates

Description-DR-SES	Transm	Distr	PPP	ND	CTC	LGC	RS	TRAC	UDC Total
Energy Charges (\$/kWh)									
On-Peak - Summer	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Semi-Peak - Summer	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Off-Peak - Summer	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Semi-Peak - Winter	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Off-Peak - Winter	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Minimum Bill (\$/day)		0.329							0.329

(Continued)

109

Advice Ltr. No. 2840-E

Decision No.

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Date Filed Dec 29, 2015

Effective Jan 1, 2016

Resolution No.



San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 21921-G
Canceling Revised Cal. P.U.C. Sheet No. 21908-G

SCHEDULE GR

Sheet 1

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

	<u>GR</u>	<u>GR-C</u>	<u>GTC/GTCA</u> ^{1/}
<u>Baseline Rate</u> , per therm (baseline usage defined in Special Conditions 3 and 4):			
Procurement Charge: ^{2/}	\$0.34561	\$0.34561 I	N/A
<u>Transmission Charge:</u>	<u>\$0.90805</u>	<u>\$0.90805</u>	<u>\$0.90805</u>
Total Baseline Charge:	\$1.25366	\$1.25366 I	\$0.90805
<u>Non-Baseline Rate</u> , per therm (usage in excess of baseline usage):			
Procurement Charge: ^{2/}	\$0.34561	\$0.34561 I	N/A
<u>Transmission Charge:</u>	<u>\$1.08354</u>	<u>\$1.08354</u>	<u>\$1.08354</u>
Total Non-Baseline Charge:	\$1.42915	\$1.42915 I	\$1.08354

^{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.

(Continued)

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Issued by
Dan Skopec
Vice President
Regulatory Affairs

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