City of Malibu

23815 Stuart Ranch Road • Malibu, California • 90265-4861
(310) 456-2489 ext. 250 • fax (310) 456-7650

April 13, 2011

Ms. Melissa Jones
Executive Director
California Energy Commission
1516 Ninth Street
Sacramento CA 95814-5514

RE: Local Energy Efficiency Standards Ordinance and Title 24 Building Energy Efficiency Standards

Dear Ms. Jones:

With this letter I submit the City of Malibu's application for establishing local energy efficiency standards. Per the request of Energy Commission staff, we would like to express to you our firm commitment that the City of Malibu will enforce the current Title 24 Building Energy Efficiency Standards as part of the implementation of our local energy ordinance. As the Chief Building Official, I will work with my staff involved in energy plan review and field inspection to improve their working knowledge of the energy standards. This includes special training as needed which focuses on enforcement of the energy standards and the particular requirements of the ordinance.

On April 11, 2011, I presented to the City Council the Malibu Local Energy Efficiency Standards Ordinance and Locally Adopted Energy Standards Cost-Effectiveness Study. Following an open public hearing at the April 11, 2011 regularly scheduled meeting, the Council adopted the conclusions of the Study showing energy savings and cost-effectiveness, approved the study and ordinance and directed staff to submit them to the Commission.

Our local energy ordinance will ensure that residential and non-residential buildings in the City of Malibu will consume no more energy than permitted by Title 24, Part 6.

Sincerely,

Victor Peterson
Community Development Director

Enclosure: Application for Locally Adopted Energy Standard

cc: Jim Thorsen, City Manager
Christi Hogin, City Attorney

Application for a Locally Adopted Energy Standard by the City of Malibu in Accordance With Section 10-106 of the California Code of Regulations, Title 24, Part 1

April 11, 2011

From:
Victor Peterson
Community Development Director
City of Malibu
23815 Stuart Ranch Road
Malibu, CA 90265
(310) 456-2489
vpeterson@ci.malibu.ca.us

Locally Adopted Energy Standards Cost-Effectiveness Study prepared by:
Walker Wells
Green Urbanism Program Director
Global Green USA
2218 Main Street, 2nd Floor
Santa Monica, CA 90405
(310) 581-2700
wwells@globalgreen.org

CITY OF MALIBU
Locally Adopted Energy Standards Cost-Effectiveness Study

March 23, 2011

Prepared by:
Walker Wells
Green Urbanism Program Director
Global Green USA
2218 Main Street, 2nd Floor
Santa Monica, CA 90405
(310) 581-2700
wwells@globalgreen.org

Contents

1.0 EXECUTIVE SUMMARY

Public Resources Code Section 25402.1(h)2 and Section 10-106 of the current California Building Energy Efficiency Standards of Title 24, Part 6 of the California Code of Regulations (Standards) establish a process which allows local adoption of energy standards that are more stringent than the statewide Standards. This process allows local governments to adopt and enforce energy standards before the statewide Standards effective date, require additional energy conservation measures, and/or set more stringent energy budgets. Because these energy standards "reach" beyond the minimum requirements of Title 24, Part 6 of the California Building Code, they are commonly referred to as Reach Codes when adopted as a collective set by a local jurisdiction.

The process for adopting a Reach Code requires that local governments apply to the California Energy Commission (CEC) for approval. The applicant jurisdiction must document the supporting analysis for determining that the proposed Reach Code Standards will save more energy than the current statewide Standards. The applicant jurisdiction must also prepare a Cost-Effectiveness Study that provides the basis of the local government's determination that the proposed Reach Code Standards are cost-effective. Once the CEC staff has verified that the local Reach Code Standards will require buildings to use no more energy than the current statewide Standards and that the documentation requirements in Section 10-106 are met, the application is brought before the full California Energy Commission for approval.

To improve energy efficiency, the City of Malibu has chosen to adopt a local reach code ordinance establishing local energy efficiency standards appropriate to its local climatic, geological, and topographic conditions. The text of the Malibu Local Energy Efficiency Standards Ordinance is included as Appendix A. The overall scope of the ordinance is summarized in Table 1 and key features of the ordinance by building type are summarized in Table 2. The Ordinance requirements supplement the minimum requirements of the 2008 California Building Energy Efficiency Standards of Title 24, Part 6 of the California Code of Regulations and will require that buildings consume no more energy than the current standards.

The City of Malibu is located within Climate Zone 6[1]. Although Southern California Edison completed a cost-effectiveness study for Climate Zone 6 in December 2009[2], City officials opted to prepare and submit this independent Study for the following reasons:

1. While all applicable projects will be required to exceed current Standards by at least 15% under the City of Malibu's proposed requirements, single family homes with conditioned floor areas greater than 5,500 square feet (SF) will be required to meet higher performance thresholds (See Table 2). This condition is not included in the Southern California Edison Study.
2. While the prototype buildings included in the Southern California Edison Study are typical building types applicable in many municipalities within Climate Zone 6, the modeled projects do not reflect closely enough design features (e.g., project type, size, orientation, glazing percentage and distribution, etc.) typical of development within the City of Malibu.

Section 2.0 of this Study consists of an analysis of the building types and performance thresholds listed in Table 2. Section 3.0 contains a cost-effectiveness determination, including incremental first costs, energy savings, payback period, and calculation of avoided carbon dioxide (CO_2) emissions. Taking into consideration specific local climatic and topographic conditions and resulting typical local building design, this Study indicates that the incremental improvement in overall annual energy performance of buildings which exceed the current Standards in accordance with the Ordinance are cost effective. Section 4.0 summarizes how the ordinance would be implemented.

1 See: http://www.energy.ca.gov/maps/building_climate_zones.html

2 The Southern California Edison Climate Zone 6 Cost-Effectiveness Study included an analysis of six prototype buildings (two single-family homes, two multifamily apartment buildings, and two office buildings) to demonstrate the cost-effectiveness of a local ordinance in Climate Zone 6 that requires applicable projects to exceed the current Standards by 15%. This study is included as Appendix B.

Table 1: Overall Scope of the Ordinance	
New ordinance or revision to previous ordinance?	New Ordinance
Projected effective date:	Within 30 days of adoption, provided that the Ordinance has also been approved by the CEC
Green building or stand-alone energy ordinance?	Stand-Alone Ordinance
Do minimum energy requirements increase after initial effective date?	No
Occupancies covered include:	Single-Family Residential Multifamily Residential Nonresidential
Energy requirements apply to new construction, additions, alterations?	New Construction and Some Additions / Alterations
Special or unusual energy requirements?	No
Third party verification?	No
Implementation details in the ordinance or in a separate document?	No special implementation guidelines. See Implementation section of this document.

Table 2: Key Features of the Ordinance by Building Type	
Structure Type (total conditioned floor area)	Must Exceed Current Energy Standards By
Single-Family Dwellings	
≤ 5,500 square feet	15.0%
> 5,500 square feet ≤ 6,250 square feet	18.3%
> 6,250 square feet ≤ 7,750 square feet	23.0%
> 7,750 square feet ≤ 9,250 square feet	27.2%
> 9,250 square feet ≤ 10,750 square feet	30.6%
> 10,750 square feet	31.9%
Multifamily Residential Buildings	
> 0 square feet	15.0%
Nonresidential Buildings	
> 0 square feet	15.0%

2.0 IMPACTS OF THE NEW ORDINANCE

Energy performance impacts of the Ordinance have been evaluated using several case studies which reflect the range of building types covered by the Ordinance. The case studies are specific to building types and conditions common to development in the City of Malibu. Modeled buildings include:

- Seven single-family homes
- One multifamily building
- One nonresidential building

Overall Case Study Method

Global Green USA researched the feasibility and energy cost-effectiveness of permit applications exceeding the 2008 Standards in order to meet the requirements of the proposed Ordinance. The case study methodology is based on how real buildings in the community are designed and evaluated in order to just meet or exceed the 2008 Standards.

First, each prototype building design was tested for compliance with the 2008 Standards. The energy measures chosen were not all the prescriptive measures, but a combination of measures which reflect how local designers, builders, and developers are likely to achieve a specified level of performance. The building designs, orientations, glazing, and prescriptive measures were selected in consultation with the City of Malibu staff to ensure the modeled buildings reflect project types typical to the City.

Second, starting with a set of measures minimally compliant with the 2008 Standards, various items were changed so the prototype projects just met the energy performance requirements of the Ordinance. Again, the design choices to meet established performance thresholds were made in consultation with the City of Malibu staff with the intent of selecting low-cost, incremental improvements.

Third, a minimum and maximum range of incremental costs for added energy measures was established through a variety of research means.

The goal of these case studies is to provide relatively real-world order-of-magnitude results that City of Malibu elected officials, staff, and citizens can use to understand and calibrate energy and cost impacts of the proposed Ordinance. In this limited study, no attempt has been made to gather statistically significant data that can be applied to all new construction projects and thereby determine the macro-effects of specific policy decisions.

2.1 Single Family Dwelling Case Studies

Prototype Designs. For each of the seven residence sizes chosen as prototypes, a typical single family home design was modeled to just meet the overall Time Dependent Valuation (TDV) energy performance requirements of the 2008 Standards using state-approved energy compliance software, called EnergyPro. Then, incremental improvements to building energy efficiency measures were made to reduce TDV energy to the percentage less than 2008 Standards, as shown in Table 2. The largest home allowable under the current Malibu Municipal Code (11,172 SF) was also modeled according to the required Ordinance threshold to ensure the standards can be met at the upper range of home sizes.

During the course of this study, it was decided that an adjustment to the residential building glazing (or fenestration) areas would more realistically match the prototype buildings to actual residential projects in Malibu. The residential baseline glazing area established in the 2008 Standards is 20% of building conditioned floor area (CFA). Because the relationship between CFA and exterior wall area is not linear, in reality small homes tend to have greater glazing-to-CFA ratios than do very large homes. Based on an analysis of glazing areas of

recently built homes in Malibu, glazing-to-CFA ratios ranging from 21.5% to 40% were assigned to the prototype buildings studied.

Base Cases, Energy Measures Needed to Exceed the 2008 Standards, and Incremental Cost Increases. The tables below indicate baseline building efficiency measures included to meet the 2008 Standards (column 2, "Baseline") and the energy features modeled so that the proposed designs use less TDV energy than the 2008 Standards (column 3, "Proposed"), in accordance with the Ordinance thresholds shown in Table 2. Incremental costs for efficiency measures associated with a significant increase in first cost are indicated on the right.

3,000 SF Single Family Dwelling 2008 Title 24 (one-story)						
Measure	Baseline	Proposed (15.0%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA) [1]	40%	40%		$0	$0	$0
Fenestration (U/SHGC) [2]	.36/.39	.36/.36		$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier [3]	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE) [4]	90%	92%	$0.10-0.15 /sf increase [5]	$300	$450	$375
Duct Insulation [6]	4.2	4.2		$0	$0	$0
Air Conditioner (SEER) [7]	13	13		$0	$0	$0
Domestic Hot Water Heater [8]	standard	tankless	Noritz NR71, EF= .82; 2 units: ($922 or $1,127*2)-(709*1)) [8]	$1,135	$1,545	$1,340
Fan Power [9]	no	no		$0	$0	$0
Quality Insulation Installation	no	no		$0	$0	$0
HERS Duct Leakage Test	yes	yes		$0	$0	$0
HERS AC Test	yes	yes		$0	$0	$0
Incremental Cost of Efficiency Measures (Materials)				**$1,435**	**$1,995**	**$1,715**
Estimated Labor Costs (40% of Construction) [10]				**$454**	**$618**	**$536**
Incremental Cost of Efficiency Measures (Total)				**$1,889**	**$2,613**	**$2,251**
Incremental Cost of Efficiency Measures (per SF)				**$0.63**	**$0.87**	**$0.75**

5,499 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (15.0%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA)	35%	35%		$0	$0	$0
Fenestration (U/SHGC)	.40/.40	.40/.40		$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE)	93%	80%	$0.15-0.30 /sf savings [5]	-$825	-$1,650	-$1,237
Duct Insulation	4.2	4.2		$0	$0	$0
Air Conditioner (SEER)	15	14	$0.10-0.12 /sf savings [5]	-$550	-$660	-$605
Domestic Hot Water Heater	tankless	tankless		$0	$0	$0
Fan Power	no	no		$0	$0	$0
Quality Insulation Installation Test	yes	no	QII labor and inspections [11]	-$1,000	-$2,000	-$1,500

5,499 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (15.0%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
HERS Duct Leakage Test	no	yes	duct leakage additional contractor scope and testing [11]	$800	$1,200	$1,000
HERS AC Test	no	no		$0	$0	$0
Incremental Cost of Efficiency Measures (Materials)				**-$1,575**	**-$3,110**	**-$2,342**
Estimated Labor Costs (40% of Construction)				**$0**	**$0**	**$0**
Incremental Cost of Efficiency Measures (Total)				**-$1,575**	**-$3,110**	**-$2,342**
Incremental Cost of Efficiency Measures (per SF)				**-$0.29**	**-$0.57**	**-$0.43**

6,250 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (18.3%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA)	32.50%	32.50%		$0	$0	$0
Fenestration (U/SHGC)	.36/.36	.37/.37	insignificant savings [5]	$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE)	92%	92%		$0	$0	$0
Duct Insulation	4.2	4.2		$0	$0	$0
Air Conditioner (SEER)	16	16		$0	$0	$0
Domestic Hot Water Heater	100 gal.	tankless	Noritz NR71, EF= .82; 3 units: ($922 or $1,127*3)-($2,033*1)) [8]	$733	$1,348	$1,041
House Wrap	yes	yes		$0	$0	$0
Fan Power	yes	no	[11]	-$500	-$750	-$625
Quality Insulation Installation Test	yes	no	QII labor and inspections [11]	-$1,000	-$2,000	-$1,500
HERS Duct Leakage Test	yes	yes		$0	$0	$0
HERS AC Test	yes	no	[11]	-$750	-$1,000	-$875
Incremental Cost of Efficiency Measures (Materials)				**-$1,517**	**-$2,402**	**-$1,960**
Estimated Labor Costs (40% of Construction)				**$293**	**$539**	**$416**
Incremental Cost of Efficiency Measures (Total)				**-$1,224**	**-$1,863**	**-$1,543**
Incremental Cost of Efficiency Measures (per SF)				**-$0.20**	**-$0.30**	**-$0.25**

7,750 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (23.0%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA)	30%	30%		$0	$0	$0
Fenestration (U/SHGC)	.39/.40	.39/.39		$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE)	92%	95%	$0.15-0.22 /sf increase [5]	$775	$1,163	$969
Duct Insulation	4.2	4.2		$0	$0	$0

7,750 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (23.0%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Air Conditioner (SEER)	16	16		$0	$0	$0
Domestic Hot Water Heater	tankless	tankless		$0	$0	$0
House Wrap	no	yes	3,563 sf @ $0.50-$0.75/sf [5]	$1,782	$2,672	$2,227
Fan Power	no	yes	[11]	$500	$750	$625
Quality Insulation Installation Test	no	yes	QII labor and inspections [11]	$1,500	$2,500	$2,000
HERS Duct Leakage Test	yes	yes		$0	$0	$0
HERS AC Test	yes	yes		$0	$0	$0
Incremental Cost of Efficiency Measures (Materials)				**$4,557**	**$7,085**	**$5,821**
Estimated Labor Costs (40% of Construction)				**$713**	**$1,069**	**$891**
Incremental Cost of Efficiency Measures (Total)				**$5,269**	**$8,154**	**$6,711**
Incremental Cost of Efficiency Measures (per SF)				**$0.68**	**$1.05**	**$0.87**

9,250 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (27.2%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA)	25%	25%		$0	$0	$0
Fenestration (U/SHGC)	.40/.40	.40/.40		$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE)	90%	93%	$0.15-0.22 /sf increase [5]	$925	$1,388	$1,156
Duct Insulation	4.2	4.2		$0	$0	$0
Air Conditioner (SEER)	13	15	$0.11-$0.13 /sf increase [5]	$1,018	$1,203	$1,111
Domestic Hot Water Heater	tankless	tankless		$0	$0	$0
House Wrap	no	yes	6,460 sf @ $0.50-$0.75/sf [5]	$3,230	$4,845	$4,038
Fan Power	no	yes	[11]	$500	$750	$625
Quality Insulation Installation Test	no	yes	QII labor and inspections [11]	$1,500	$2,500	$2,000
HERS Duct Leakage Test	no	yes	duct leakage additional contractor scope and testing [11]	$800	$1,200	$1,000
HERS AC Test	no	yes	[11]	$750	$1,000	$875
Incremental Cost of Efficiency Measures (Materials)				**$8,723**	**$12,886**	**$10,804**
Estimated Labor Costs (40% of Construction)				**$1,292**	**$1,938**	**$1,615**
Incremental Cost of Efficiency Measures (Total)				**$10,015**	**$14,824**	**$12,419**
Incremental Cost of Efficiency Measures (per SF)				**$1.08**	**$1.60**	**$1.34**

10,750 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (30.6%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA)	22%	22%		$0	$0	$0

10,750 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (30.6%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration (U/SHGC)	.40/.40	.40/.40		$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE)	95%	94%	$0.05-0.07 /sf savings [5]	-$538	-$806	-$672
Duct Insulation	4.2	4.2		$0	$0	$0
Air Conditioner (SEER)	16	16		$0	$0	$0
Domestic Hot Water Heater	75 gal. (2)	tankless	Noritz NR71, EF= .82; 5 units: ($922 or $1,127*5)-($1,575*2)) [8]	$1,460	$2,485	$1,973
House Wrap	yes	yes		$0	$0	$0
Fan Power	yes	no	[11]	-$500	-$750	-$625
Quality Insulation Installation Test	yes	yes		$0	$0	$0
HERS Duct Leakage Test	yes	yes		$0	$0	$0
HERS AC Test	yes	yes		$0	$0	$0
Incremental Cost of Efficiency Measures (Materials)				**$423**	**$929**	**$676**
Estimated Labor Costs (40% of Construction)				**$584**	**$994**	**$789**
Incremental Cost of Efficiency Measures (Total)				**$1,007**	**$1,923**	**$1,465**
Incremental Cost of Efficiency Measures (per SF)				**$0.09**	**$0.18**	**$0.14**

11,172 SF Single Family Dwelling 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (31.9%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA)	21.50%	21.50%		$0	$0	$0
Fenestration (U/SHGC)	.40/.40	.40/.40		$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE)	92%	92%		$0	$0	$0
Duct Insulation	4.2	4.2		$0	$0	$0
Air Conditioner (SEER)	15	15		$0	$0	$0
Domestic Hot Water Heater	75 gal. (2)	tankless	Noritz NR71, EF= .82; 5 units: ($922 or $1,127*5)-($1,575*2)) [8]	$1,460	$2,485	$1,973
House Wrap	yes	yes		$0	$0	$0
Fan Power	yes	yes		$0	$0	$0
Quality Insulation Installation Test	yes	yes		$0	$0	$0
HERS Duct Leakage Test	yes	yes		$0	$0	$0
HERS AC Test	yes	no	[11]	-$750	-$1,000	-$875
Incremental Cost of Efficiency Measures (Materials)				**$710**	**$1,485**	**$1,098**
Estimated Labor Costs (40% of Construction)				**$584**	**$994**	**$789**
Incremental Cost of Efficiency Measures (Total)				**$1,294**	**$2,479**	**$1,887**
Incremental Cost of Efficiency Measures (per SF)				**$0.12**	**$0.22**	**$0.17**

2.2 Multifamily Building Case Study

Prototype Design. A typical multifamily building design was modeled to just meet the overall TDV energy performance requirements of 2008 Standards using a 2008 Standards version of EnergyPro. Then, incremental improvements to building energy efficiency measures were made to reduce TDV energy to the percentage less than 2008 Standards shown in Table 2.

Base Cases, Energy Measures Needed to Exceed the 2008 Standards, and Incremental Cost Increases. The table below indicates baseline building efficiency measures included to meet the 2008 Standards (column 2, "Baseline") and the energy features modeled so that the proposed design uses less TDV energy than the 2008 Standards (column 3, "Proposed"), in accordance with the Ordinance thresholds shown in Table 2. Incremental costs for efficiency measures associated with a significant increase in first cost are indicated on the right.

15,000 SF 6-Unit Multifamily Building 2008 Title 24 (two-story)						
Measure	Baseline	Proposed (15.0%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Fenestration Area (% of CFA)	25%	25%		$0	$0	$0
Fenestration (U/SHGC)	.40/.40	.38/.38	insignificant cost increase [5]	$0	$0	$0
Roof Insulation	R-30	R-30		$0	$0	$0
Radiant Barrier	no	no		$0	$0	$0
Walls	R-13	R-13		$0	$0	$0
Forced Air Unit (AFUE)	90%	90%		$0	$0	$0
Duct Insulation	4.2	4.2		$0	$0	$0
Air Conditioner (SEER)	16	16		$0	$0	$0
Domestic Hot Water Heater	standard	tankless	Noritz NR71, EF= .82; 6 units: ($922 or $1,127*6)-(709*6)) [8]	$1,278	$2,508	$1,893
Quality Insulation Installation Test	yes	yes		$0	$0	$0
HERS Duct Leakage Test	yes	yes		$0	$0	$0
Incremental Cost of Efficiency Measures (Materials)				**$1,278**	**$2,508**	**$1,893**
Estimated Labor Costs (40% of Construction)				**$511**	**$1,003**	**$757**
Incremental Cost of Efficiency Measures (Total)				**$1,789**	**$3,511**	**$2,650**
Incremental Cost of Efficiency Measures (per SF)				**$0.12**	**$0.23**	**$0.18**

2.3 Nonresidential Building Case Study

Prototype Design. A large grocery store prototype was modeled to just meet the overall TDV energy performance requirements of 2008 Standards using a 2008 Standards version of EnergyPro. Then, incremental improvements to building energy efficiency measures were made to reduce TDV energy to the percentage less than 2008 Standards shown in Table 2.

Base Cases, Energy Measures Needed to Exceed the 2008 Standards, and Incremental Cost Increases. The table below indicates baseline building efficiency measures included to meet the 2008 Standards (column 2, "Baseline") and the energy features modeled so that the proposed design uses less TDV energy than the 2008 Standards (column 3, "Proposed"), in accordance with the Ordinance thresholds established in Table 2. Incremental costs for efficiency measures associated with a significant increase in first cost are indicated on the right.

25,000 SF Nonresidential Building 2008 Title 24						
Measure	Baseline	Proposed (15.0%)	Notes	Incremental Cost Est.		
				Min.	Max.	Avg.
Roof Insulation	R-19	R-30	25,000 sf @ $0.10-$0.12/sf [5]	$2,500	$3,000	$2,750
Cool Roof (prescriptive std.)	yes	yes		$0	$0	$0
CMU Walls	No furring	R-13/ wood frame furring	10,239 sf @ $0.33-$0.37/sf [5]	$3,379	$3,788	$3,584
Fixed Storefront: Solarban 60/ Clear Low-E dual-pane, standard metal frame. SHGC = 0.38	yes	yes		$0	$0	$0
Storefront Area: 40% of south wall area	yes	yes		$0	$0	$0
Skylights: Tint dual-pane, standard metal frame	yes	yes		$0	$0	$0
Skylight Area: prescriptive standard is 3.3% minimum at 50% of store floor area (for mandatory daylighting). Modeled: 4% of interior AC zone, modeled at 50% of toal store floor area. 12,500 SF * 0.4= 500 SF	yes	yes		$0	$0	$0
Fenestration Shading	no	yes	160' wide w/ 5' projection, 1' above storefront, $100-106 /lf [12]	$45,967	$58,415	$52,191
Package AC units (EER/AFUE)	11.2/82%	12.0/82%	$.32-$0.48 /sf increase [13]	$8,000	$12,000	$10,000
Lighting Power: prescriptive allowance 1.5 watts/SF	1.5 W/SF	1.10 W/SF	$0.05-$0.1/sf [5]	$1,250	$2,500	$1,875
Automatic Daylighting Controls [14]	yes	yes		$0	$0	$0
Incremental Cost of Efficiency Measures (Materials)				**$61,096**	**$79,703**	**$70,400**
Estimated Labor Costs (40% of Construction)				**$1,352**	**$1,515**	**$1,433**
Incremental Cost of Efficiency Measures (Total)				**$62,447**	**$81,219**	**$71,833**
Incremental Cost of Efficiency Measures (per SF)				**$2.50**	**$3.25**	**$2.87**

Notes:
1. CFA = conditioned floor area
2. Notes on fenestration:
   U-Value = The capacity of an insulating material to prevent heat from escaping.
   SHGC = Solar Heat Gain Coefficient; how well a material blocks heat caused by sunlight.
   Single-family residence fenestration distribution: 50% on South; remaining area equally distributed on N, E and W. Small variances in fenestration U-factor were used to fine-tune energy budget to goal.
3. Radiant Barrier: This is a residential prescriptive requirement in warm climate zones, not in Climate Zone 6. Radiant Barrier was not used as an efficiency measure because this measure was yielding a very large efficiency gain, which in our opinion was not commensurate with the Malibu area climate. (As a test, we ran a 3,000 sq. ft. house using EnergyPro 4/'05 Title 24, and the efficiency gain provided by using RB was much less.) Radient barrier is not a nonresidential building efficiency credit.
4. FAU = Forced Air Unit, a typical central gas furnace. Efficiency is measured in AFUE (Annual Fuel Utilization Efficiency).
5. Per quote from general contractor
6. Residential duct insulation: R-4.2 is the prescriptive requirement in Climate Zone 6.
7. AC = Air Conditioner. For most homes, this is the outdoor condenser which generates chilled fluid that circulates to the FAU, using the FAU's fan and ducts to transmit cool air. Efficiency is measured in SEER (Seasonal Energy Efficiency Ratio).
8. Notes on domestic water heaters: "Standard" water heating system is one natural gas storage type (per dwelling unit), 50 gallons maximum, no recirculation. For all of the baseline residential water heating, except for the smallest house and the multi-family structure, the city suggested various combinations of water heaters – mostly one or two 75 gallon, or one 100 gallon, natural gas with recirculation.

Because the baseline houses have more glazing than the Title 24 prescriptive allowance, in some cases the storage type water heater would not comply, or a smaller water heater than suggested was required to comply – even when all approved efficiency measures were employed. The recirculation system is modeled with time and temperature controls. The modeled Noritz tankless water heater is model NR71. This gas-fired model was selected because it is of moderate capacity, efficiency, and price, among tankless makes and models. This model has an EF (Efficiency) of .82. New condensing tankless water heaters have EF's in the 90% range. Quantity of tankless water heaters has no effect on the energy budget. The quantity listed is simply an estimate based on house size. Kitchen hot water pipe insulation: this is a residential prescriptive standard, modeled on all prototype buildings. Quotes for cost differences between "baseline" and "proposed" cases are from a number of sources.

9. Airflow/Fan Power: These are two separate efficiency measures for which credit may be taken. The Fan Power credit is only available when the Airflow credit is also exercised. Because these individual credits are relatively small, for simplicity these two credits were always modeled as a pair. Compliance information about these, and other efficiency credits, may be found in the '08 Residential Compliance Manual.
10. Estimated labor costs consist of an assumption of 40% of equipment costs (increases or decreases) when a alternate strategy is applied between the baseline and proposed case. In some cases, this can result in a negative number if a labor cost savings is expected.
11. Per quote from HERS rater
12. Per quote from awning manufacturer / installer
13. Per quote from HVAC distributor
14. Automatic Daylighting Controls: prescriptive requirement at skylit daylit area (assumes 15' ceiling height minimum). Model interior AC zone lighting power at 1.357 watts/SF to simulate control credit.

3.0 ANALYSIS OF COSTS & AVOIDED $C0_2$ EMISSIONS

The tables in this section are based upon the following:

- Incremental site electricity (kWh) and natural gas (therms) saved per year as calculated using the state-approved energy compliance software;
- Average utility rate schedules as follows (in constant dollars):
  - Residential buildings:
    Electricity: Edison D-6 ($0.17-$0.18/kWh)
    Natural Gas: SOCAL Gas GR1 ($1.09-$1.12/therm)
  - Nonresidential buildings
    Electricity: SCE TOU-8 ($0.14/kWh)
    Natural Gas: SoCal Gas GN-10 ($1.11/therm)
- The assumption that there is no change (i.e., no inflation or deflation) in utility rates in constant dollars over time
- The assumption that there is no increase in summer temperatures even though most scientific studies predict that global climate change will increase temperatures in the Western U.S. which will increase air conditioning energy use
- Energy Costs are annual. Residential energy costs only include space conditioning and domestic hot water (i.e., lighting and appliance electric use is excluded). Nonresidential energy costs include space conditioning, lighting, and nominal (Title 24 standard) receptacle/miscellaneous electric loads
- Simple Payback includes neither the cost of financing nor any external cost associated with global climate change

The data summarized here is intended only to be illustrative, not comprehensive or definitive, in demonstrating the scale and the variability of results, depending on the selection of energy measures and assumed first costs. Note that where cost savings were achieved, negative dollars and years (payback period) are shown.

3.1 Single Family Dwellings

3,000 SF Single Family Dwelling 2008 Title 24 (one-story)	
Annual Baseline Energy Cost	$552
Annual Proposed Energy Cost	$475
Average Incremental First Cost	$2,251

3,000 SF Single Family Dwelling 2008 Title 24 (one-story)	
Net Incremental Annual Energy Costs Savings	$77
Simple Payback (years)	29.2
Annual Carbon Emissions Reduction (lbs./yr, total)	765
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.26

5,499 SF Single Family Dwelling 2008 Title 24 (two-story)	
Annual Baseline Energy Cost	$658
Annual Proposed Energy Cost	$565
Average Incremental First Cost	-$2,342
Net Incremental Annual Energy Costs Savings	$93
Simple Payback (years)	-25.2
Annual Carbon Emissions Reduction (lbs./yr, total)	766
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.14

6,250 SF Single Family Dwelling 2008 Title 24 (two-story)	
Annual Baseline Energy Cost	$676
Annual Proposed Energy Cost	$567
Average Incremental First Cost	-$1,543
Net Incremental Annual Energy Costs Savings	$109
Simple Payback (years)	-14.2
Annual Carbon Emissions Reduction (lbs./yr, total)	1,392
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.22

7,750 SF Single Family Dwelling 2008 Title 24 (two-story)	
Annual Baseline Energy Cost	$726
Annual Proposed Energy Cost	$565
Average Incremental First Cost	$6,711
Net Incremental Annual Energy Costs Savings	$161
Simple Payback (years)	41.7
Annual Carbon Emissions Reduction (lbs./yr, total)	1,346
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.17

9,250 SF Single Family Dwelling 2008 Title 24 (two-story)	
Annual Baseline Energy Cost	$777
Annual Proposed Energy Cost	$570
Average Incremental First Cost	$12,419
Net Incremental Annual Energy Costs Savings	$207
Simple Payback (years)	60.0
Annual Carbon Emissions Reduction (lbs./yr, total)	1,681
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.18

10,750 SF Single Family Dwelling 2008 Title 24 (two-story)	
Annual Baseline Energy Cost	$800
Annual Proposed Energy Cost	$578
Average Incremental First Cost	$1,465
Net Incremental Annual Energy Costs Savings	$222
Simple Payback (years)	6.6
Annual Carbon Emissions Reduction (lbs./yr, total)	2,548
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.24

11,172 SF Single Family Dwelling 2008 Title 24 (two-story)	
Annual Baseline Energy Cost	$814
Annual Proposed Energy Cost	$573
Average Incremental First Cost	$1,887
Net Incremental Annual Energy Costs Savings	$241
Simple Payback (years)	7.8
Annual Carbon Emissions Reduction (lbs./yr, total)	2,643
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.24

3.2 Multifamily Building

15,000 SF 6-Unit Multifamily Building 2008 Title 24 (two-story)	
Annual Baseline Energy Cost	$2,355
Annual Proposed Energy Cost	$1,919
Average Incremental First Cost	$2,650
Net Incremental Annual Energy Costs Savings	$436
Simple Payback (years)	6.1
Annual Carbon Emissions Reduction (lbs./yr, total)	4,465
Annual Carbon Emissions Reduction (lbs./yr, per SF)	0.30

3.3 Nonresidential Building

25,000 SF Nonresidential Building 2008 Title 24	
Annual Baseline Energy Cost	$51,422
Annual Proposed Energy Cost	$43,706
Average Incremental First Cost	$71,833
Net Incremental Annual Energy Costs Savings	$7,716
Simple Payback (years)	9.3
Annual Carbon Emissions Reduction (lbs./yr, total)	50,331
Annual Carbon Emissions Reduction (lbs./yr, per SF)	2.01

3.4 Cost-Effectiveness Determination

Taking into consideration specific local climatic and topographic conditions and resulting typical local building design, the study indicates that the incremental improvement in overall annual energy performance of buildings which exceed the current standards in accordance with the Ordinance are cost effective. However, each building's overall design, occupancy type, and specific design choices may allow for a large range of incremental costs for exceeding the current standards, estimated annual energy cost savings, and payback period. As with simply meeting the minimum requirements of the current energy Standards, a permit applicant complying with the energy requirements of the Ordinance should carefully analyze building energy performance early in the design process in order to identify ways to minimize incremental first cost and reduce payback periods associated with implementing energy efficiency measures.

4.0 IMPLEMENTATION PLAN

The implementation of the City of Malibu Energy Ordinance for low-rise residential buildings is a simple verification that the performance CF-1R form demonstrates that the proposed building exceeds 2008 Standards by at least 15% or the applicable percentage specified based on the dwelling square footage. For nonresidential buildings, the PERF-1 is checked to verify that the TDV energy of the proposed building is at least 15% less than the standard design TDV energy. In the %-better-than calculation, process/receptacle energy use components are omitted.

The City of Malibu plan review will involve:

(a) Verifying the occupancy type(s) and scope of work to determine whether and how the ordinance applies;
(b) Checking the drawings, specifications, and Title 24 documentation to ensure compliance under the 2008 Building Energy Efficiency Standards; and,
(c) Checking any additional drawings or specifications or compliance forms needed to demonstrate compliance with the Ordinance.

Field inspection will be identical to working with the 2008 Standards or subsequently adopted state energy standards, whichever is applicable at the time of the building permit application.

APPENDIX A

CITY OF MALIBU LOCAL ENERGY EFFICIENCY STANDARDS ORDINANCE

ORDINANCE NO. 357

AN ORDINANCE OF THE CITY OF MALIBU ADDING CHAPTER 15.18, LOCAL ENERGY EFFICIENCY STANDARDS, TO THE MALIBU MUNICIPAL CODE FOR THE PURPOSE OF ADOPTING LOCAL ENERGY EFFICIENCY STANDARDS FOR BUILDINGS COVERED BY THE 2008 CALIFORNIA BUILDING ENERGY EFFICIENCY STANDARDS

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

SECTION 1. Findings.

1. California Health and Safety Code Sections 18938 and 17958 provide that the California Building Standards Code establishes building standards for all occupancies throughout the State.

2. This ordinance preserves and enhances the environment, by setting forth minimum energy efficiency standards within the City of Malibu for all new single-family dwellings, multifamily residential construction, nonresidential construction and substantial remodels.

3. No dwellings, construction and substantial remodels subject to this Ordinance shall consume more energy than what is permitted by the 2008 Building Energy Efficiency Standards (Title 24, Part 6) of the California Building Code.

4. Walker Wells, Global Green USA, prepared a report entitled "City of Malibu Locally Adopted Energy Standards Cost Effectiveness Study, dated March 23, 2011 (the "Energy Cost Effectiveness Study"), which is on file in the Office of the City Clerk.

5. The Energy Cost Effectiveness Study has studied the cost effectiveness of the energy efficiency measures contained in this Ordinance for the Climate Zone within the City's jurisdiction (Climate Zone 6) and concluded that the energy efficiency measures contained in this Ordinance are cost-effective.

6. Pursuant to Health and Safety Code Sections 17958.5, 17958.7 and 18941.5, the City Council hereby expressly finds the following energy efficiency modifications to the California Building Energy Efficiency Standards as set forth in this Ordinance are reasonably necessary because of the City's local climatic, geographical or topographical conditions. In the United States, buildings account for 40 percent of total energy use, 14 percent of total water consumption, 72 percent of total electricity consumption and 39 percent of the carbon dioxide emissions, according to statistics provided by federal environmental agencies. The average new residence constructed in Malibu is larger than 5,500 square feet and such residences typically feature a high proportion of window area to floor area and a high proportion of windows oriented toward the south. These design characteristics often result in residences with significant energy and natural resource demands. Reduction of energy usage in residential and nonresidential buildings as a result of efficiencies required by this Ordinance is likely to have local benefits such as

reducing increased peak load energy demands that can cause power outages or power reductions (*i.e.*, "brown-outs") which affect public safety and can cause adverse local economic impacts, decreasing overall electricity demand, and reducing greenhouse gas emissions. These benefits are likely to become increasingly important as the effects of global warming and climate change are felt locally. Due to local climate and topographic conditions, it is reasonably necessary to enhance the California Energy Code requirements for new single-family dwellings, multifamily residential construction, nonresidential construction and substantial remodels.

7. In reliance upon the Energy Cost Effectiveness Study and all available evidence, the City Council hereby adopts the conclusions of this Study and authorizes its inclusion in an application for consideration by the California Energy Commission in compliance with Public Resources Code 25402.1(h)(2). Specifically, the City Council finds that the energy efficiency measures contained in this ordinance are cost-effective.

SECTION 2. Adoption. Chapter 15.18, "Local Energy Efficiency Standards," is hereby added to Title 15 of the Malibu Municipal Code to read as follows:

Chapter 15.18. Local Energy Efficiency Standards

15.18.010. Purpose.

This purpose of this Chapter is to promote the health, safety and welfare of the City's residents, workers and visitors by minimizing the use and waste of energy in the construction and operation of the City's building stock. This Chapter sets forth minimum energy efficiency standards within the City for all new residential and nonresidential construction. This Chapter is intended to supplement the 2008 California Building Energy Efficiency Standards, as specified in California Code of Regulations, Title 24, Parts 1 and 6 (Standards). Compliance with the 2008 California Building Energy Efficiency Standards is required even if the increased minimum energy efficiency standards specified in this Chapter do not apply.

15.18.020. Scope.

This Chapter contains regulations relating to the energy efficiency standards for all single-family dwellings, multifamily residential and nonresidential construction.

15.18.030. Definitions.

For purposes of this Chapter 15.18, words or phrases used in this Chapter that are specifically defined in Parts 1, 2 or 6 of Title 24 of the California Code of Regulations shall have the same meaning as given in the Code of Regulations. In addition, for the purposes of this Chapter 15.18, the following words and phrases shall have the meanings indicated, unless context or usage clearly requires a different meaning:

"Alternative proposed design credit" means an energy credit for alternative energy system designs that may be used to achieve compliance with the requirements of this Chapter subject to approval of the building official. Alternative energy system designs may include, but are not limited to, any renewable energy system which is not a solar photovoltaic system and any

energy efficiency measures not included in the Title 24 performance analysis, which significantly exceed current building practice or applicable minimum state or federal efficiency standards. The permit applicant must submit calculations to document, explain and justify the amount of the credit claimed.

"Current energy standards" means the 2008 California Building Energy Efficiency Standards or subsequently adopted state energy standards and regulations by the California Energy Commission, contained in Parts 1 and 6 of Title 24 of the California Code of Regulations, which are in effect at the time of application of the building permit

"Photovoltaic (PV) credit" means a Time Dependent Valuation (TDV) energy credit that may be used to achieve compliance with the requirements of this Chapter. This credit is available if the solar photovoltaic energy system is capable of generating electricity from sunlight, supplying the electricity directly to the building, and the system is connected, through a reversible meter, to the utility grid. The methodology used to calculate the energy equivalent to the photovoltaic credit shall be the California Energy Commission Photovoltaic (CECPV) calculator, using the most recent version prior to the permit application date, which may be found at the following website: http://www.gosolarcalifornia.ca.gov/tools/nshpcalculator/download_calculator.php.

"Solar photovoltaic energy system" means a photovoltaic solar collector or other photovoltaic solar energy device that has a primary purpose of providing for the collection and distribution of solar energy for the generation of alternating current rated peak electricity. The installation of any solar photovoltaic energy system must meet all installation criteria of the current edition of the California Electrical Code and the California Energy Commission's Guidelines for Eligibility Criteria and Conditions for Solar Energy System Incentives, Senate Bill 1.

"Substantial remodel" means the renovation of any structure, which, combined with any proposed additions to the structure, affects a floor area which exceeds fifty (50) percent of the existing enclosed floor area of the structure. For purposes of applying this definition, when any structural changes are made in or on the building, such as walls, columns, beams, girders, headers, floor joists, ceiling joists, roof rafters, roof diaphragms, foundations or similar structural components, or when interior work requiring a building permit is proposed, the floor area of all rooms affected by such construction shall be included in calculating floor area. This definition does not apply to the repair, maintenance or replacement of roof coverings, and in the case of beachfront properties, to the repair, maintenance or replacement of foundation elements.

For a multifamily structure, renovation described above affecting more than fifty (50) percent of the existing enclosed floor area within an individual unit is a substantial remodel of that unit, and renovation affecting more than fifty (50) percent of the existing enclosed floor area within a multifamily structure under single ownership is a substantial remodel of that structure. Similarly, for a nonresidential structure, such renovation affecting more than fifty (50) percent of the existing enclosed floor area within an individual tenant space or unit is a substantial remodel of that space or unit, while renovation affecting more than fifty (50) percent of the existing enclosed floor area within a nonresidential structure under single ownership is a substantial remodel of that structure.

"Time Dependent Valuation" means the time varying energy caused to be used by the building or addition to provide space conditioning and water heating and, for specified buildings, lighting. TDV energy accounts for the energy used at the building site and consumed in producing and in delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses. TDV Energy is expressed in terms of thousands of British thermal units per square foot per year (kBtu/sq.ft.-yr).

15.18.040. Applicability. The provisions of this Chapter shall apply to the following types of building projects involving conditioned floor area for which a building permit is applied for and accepted as complete by the Environmental and Building Safety Division after the effective date of this Chapter:

1. New single-family dwellings.

2. Additions to single-family dwellings where Title 24 energy performance documentation is required which uses the "Existing + Addition" or "Existing + Addition + Alteration" calculation method.

3. New multifamily residential construction.

4. New nonresidential construction.

5. Substantial remodels, as defined in this Chapter, to single-family residential dwellings, multifamily units or structures, and nonresidential units or structures, where Title 24 energy performance documentation is required which uses the "Existing + Addition" or "Existing + Addition + Alteration" calculation method. (For purposes of this Chapter, the terms "remodel" and "alteration" are synonymous.)

15.18.050. Compliance. No building permit for a project subject to the provisions of this Chapter shall be issued by the Environmental and Building Safety Manager unless the energy compliance documentation submitted with the permit application meets the requirements of this Chapter. No certificate of occupancy shall be granted until a certificate of field verification and diagnostic testing (CF-4R) for the permitted project is submitted to the Environmental and Building Safety Manager when applicable. No certificate of occupancy shall be granted unless the work authorized under a permit has been constructed in accordance with the approved plans, conditions of approval and requirements of this Chapter.

15.18.060. General Requirements.
In addition to meeting all requirements of 2008 Building Energy Efficiency Standards, all buildings or improvements covered by this Chapter shall include the following mandatory energy efficiency measures as may be applicable to the proposed building or improvement:

1. All structures subject to the provisions of this Chapter shall exceed the current energy standards using the Title 24 performance approach by the percentage indicated in the compliance table based on the structure type and, if applicable, the structure's resultant total conditioned floor area.

Compliance Table	
Structure Type (total conditioned floor area)	**Must Exceed Current Energy Standards By**
Single-Family Dwellings	
≤ 5,500 square feet	15.0 %
> 5,500 square feet ≤ 6,250 square feet	18.3 %
> 6,250 square feet ≤ 7,750 square feet	23.0 %
> 7,750 square feet ≤ 9,250 square feet	27.2 %
> 9,250 square feet ≤ 10,750 square feet	30.6 %
> 10,750 square feet	31.9 %
Multifamily Residential Buildings	
> 0 square feet	15.0 %
Nonresidential Buildings	
> 0 square feet	15.0 %

2. New single-family dwellings subject to the provisions of this Chapter shall meet both of the following:

a. Exceed the current energy standards as specified in the compliance table, using the performance compliance approach; and

b. Meet all other provisions applicable to low-rise residential buildings contained in the current energy standards.

3. Additions and/or alterations to single-family dwellings subject to the provisions of this Chapter shall meet one of the following requirements:

a. The addition and/or alteration shall comply with subsection D(2) based on the resulting total conditioned floor area of the dwelling; or

b. The energy efficiency of the existing building shall be improved so that the existing building plus the addition and/or alteration meet the requirements listed in the compliance table.

4. For building projects which are required by subsections D(2) or D(3) to exceed the current energy standards more than fifteen (15) percent, as long as the performance compliance approach is used to achieve a minimum efficiency of fifteen (15) percent beyond the current standards, then the applicant shall have the option of using the PV credit and/or the alternative proposed design credit to comply with the remaining percentage required in the compliance table.

5. When a permit applicant is applying for PV credit or an alternative proposed design credit, in addition to the standard Title 24 report, a special compliance and calculation form, which shall be available at the Environmental and Building Safety Division, shall be submitted with the building permit application and included on all plan sets with the CF-1R form to document compliance with the provisions of this Chapter.

6. When an applicant's chosen compliance path under these local standards requires field verification by a certified Home Energy Rating System (HERS) rater, verification shall be in

accordance with the protocols established in the HERS Residential Field Verification and Diagnostic Testing Regulations Manual. A CF-4R form, when required by the current energy standards, shall be submitted to the Environmental and Safety Division to demonstrate compliance prior to issuance of a certificate of occupancy.

15.18.070. **Modifications**. Whenever there are practical difficulties involved with carrying out the literal provisions of this Chapter, the building official, in consultation with the Community Development Director and Environmental and Building Safety Manager, based on substantial evidence of necessity, may grant modifications to the extent necessary to account for practical difficulties for individual cases, upon application by the owner or owner's representative, provided that the building official determines the requested modification is in compliance with the intent and purpose of this Chapter and complies with the minimum requirements of the current energy standards. For the purposes of this section "practical difficulties" shall mean a conflict between the requirements of this Chapter and conditions imposed on a project through a previously approved application, physical conditions of a project site which make it infeasible to achieve the standards for compliance, or costs for achieving compliance which are disproportionate to the overall cost of the project.

SECTION 3. The City Manager or his designee shall submit this ordinance along with an application for consideration by the California Energy Commission in compliance with Public Resources Code 25402.1(h)(2).

SECTION 4. Severability. Should any section, subsection, paragraph, sentence, clause, or phrase of this Ordinance be declared unconstitutional or invalid by a court of competent jurisdiction for any reason, such declaration shall not affect the validity of the remaining portions of this Ordinance.

SECTION 5. Environmental Compliance. In accordance with California Public Resources Code Section 15061(b)(3), the California Environmental Quality Act (CEQA) "applies only to projects, which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA." Staff has determined that the proposed Ordinance is exempt from CEQA review.

SECTION 6. Construction. The City Council intends this Ordinance to supplement, not to duplicate or contradict, applicable state and federal law and this Ordinance shall be construed in light of that intent.

SECTION 7. Effective Date. This Ordinance shall be in full force and effective 30 days after its adoption, provided that the Ordinance has also been approved by the California Energy Commission by that date, and shall be published or posted as required by law.

SECTION 8. Certification. The City Clerk is directed to certify the passage and adoption of this Ordinance; cause it to be entered into the City of Malibu's book of original ordinances; make a

note of the passage and adoption in the records of this meeting; and, within fifteen days after the passage and adoption of this Ordinance, cause it to be published or posted in accordance with California law.

PASSED AND ADOPTED this ____ day of _____, 2011.

_____
JOHN SIBERT, Mayor

ATTEST:

_____
LISA POPE, City Clerk
(seal)

APPROVED AS TO FORM:

_____
CHRISTI HOGIN, City Attorney

APPENDIX B

SOUTHERN CALIFORNIA EDISON CLIMATE ZONE 6

COST-EFFECTIVENESS STUDY

CA Statewide Codes and Standards Program
Title 24 Local Energy Efficiency Ordinances

Title:
Climate Zone 6
Energy Cost-Effectiveness Study

Prepared for:
Randall Higa
Senior Engineer
Southern California Edison
626.815.7259
Email: Randall.Higa@sce.com

Prepared by:
Michael Gabel
Gabel Associates, LLC
510.428.0803
Email: mike@gabelenergy.com

Last Modified: December 24, 2009

The Gas Company
A Sempra Energy utility
SDGE
A Sempra Energy utility
SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company
PG&E
Pacific Gas and Electric Company

LEGAL NOTICE

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

Table of Contents

1.0 Executive Summary

Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards (Standards) establish a process which allows local adoption of energy standards that are more stringent than the statewide Standards. This process allows local governments to adopt and enforce energy standards before the statewide Standards effective date, require additional energy conservation measures, and/or set more stringent energy budgets. Because these energy standards "reach" beyond the minimum requirements of Title 24, Part 6 of the California Building Code, they are commonly referred to as Reach Codes when adopted as a collective set by a local jurisdiction.

The process for adopting a Reach Code requires that local governments apply to the California Energy Commission (CEC) for approval. The applicant jurisdiction must document the supporting analysis for determining that the proposed Reach Code Standards will save more energy than the current statewide Standards. The applicant jurisdiction must also prepare a **Cost Effectiveness Study** that provides the basis of the local government's determination that the proposed Reach Code Standards are cost-effective. Once the CEC staff has verified that the local Reach Code Standards will require buildings to use no more energy than the current statewide Standards and that the documentation requirements in Section 10-106 are met, the application is brought before the full California Energy Commission for approval.

This Cost Effectiveness Study was prepared for Climate Zone 6 which encompasses all or a portion of 60 incorporated coastal cities located within Santa Barbara, Ventura, Los Angeles, and Orange counties (see Appendix "A" for list of cities). The 2008 Building Energy Efficiency Standards, effective January 1, 2010, have been used as the baseline used in calculating the energy performance of efficiency measures summarized in this study.

2.0 Methodology and Assumptions

The energy performance impacts of exceeding the performance requirements of the 2008 Title 24 Building Energy Efficiency Standards (2008 Standards) have been evaluated in Climate Zone 6 using the following residential and nonresidential prototypical building types:

Small Single Family House 2-story 2,025 sf	**Large Single Family House** 2-story 4,500 sf
Low-rise Multi-family Apartments 8 dwelling units/2-story 8,442 sf	**High-rise Multi-family Apartments** 40 dwelling units/4-story 36,800 sf
Low-rise Office Building 1-story 10,580 sf	**High-rise Office Building** 5-story 52,900 sf

Methodology

The methodology used in the case studies is based on a design process for each of the proposed prototypical building types that first meets the minimum requirements and then exceeds the 2008 Standards by 15%. The process includes the following major stages:

Stage 1: Minimum Compliance with 2008 Standards:

Each prototype building design is tested for minimum compliance with the 2008 Standards, and the mix of energy measures are adjusted using common construction options so the building first just meets the Standards. The set of energy measures chosen represent a reasonable combination which reflects how designers, builders and developers are likely to achieve a specified level of performance using a relatively low first incremental (additional) cost

Stage 2: Incremental Cost for Exceeding 2008 Standards by 15%:

Starting with that set of measures which is minimally compliant with the 2008 Standards, various energy measures are upgraded so that the building just exceeds the 2008 Standards by 15%. The design choices by the consultant authoring this study are based on many years of experience with architects, builders, mechanical engineers; and general knowledge of the relative acceptance and preferences of many measures, as well as their incremental costs. This approach tends to reflect how building energy performance is typically evaluated for code compliance and how it's used to select design energy efficiency measures. Note that lowest simple payback with respect to building site energy is not the primary focus of selecting measures; but rather the requisite reduction of Title 24 Time Dependent Valuation(TDV) energy at a reasonable

incremental cost consistent with other non-monetary but important design considerations. A minimum and maximum range of incremental costs of added energy efficiency measures is established by a variety of research means. A construction cost estimator, Building Advisory LLC, was contracted to conduct research to obtain current measure cost information for many energy measures; and Gabel Associates performed its own additional research to establish first cost data.

Stage 3 Cost Effectiveness Determination:

Energy savings in kWh and therms is calculated from the Title 24 simulation results to establish the annual energy cost savings and CO2-equivalent reductions in greenhouse gases. A simple payback analysis in years is calculated by dividing the incremental cost for exceeding the 2008 Standards by the estimated annual energy cost savings.

Assumptions

Annual Energy Cost Savings

1. Annual site electricity (kWh) and natural gas (therms) saved are calculated using a beta version of the state-approved energy compliance software for the 2008 Building Energy Efficiency Standards, Micropas 8.

2. Average residential utility rates of $0.159/kWh for electricity and $0.94/therm for natural gas in current constant dollars; nonresidential rates are time-of-use rate schedules modeled explicitly in the DOE-2.1E computer simulation: Southern California Edison GS-1 schedule for electricity and Southern California Gas GN-10 schedule for natural gas.

3. No change (i.e., no inflation or deflation) of utility rates in constant dollars

4. No increase in summer temperatures from global climate change

Simple Payback Analysis

1. No external cost of global climate change -- and corresponding value of additional investment in energy efficiency and CO_2 reduction – is included

2. The cost of money (e.g., opportunity cost) invested in the incremental cost of energy efficiency measures is not included.

3.0 Minimum Compliance with 2008 Standards

The following energy design descriptions of the following building prototypes just meet the 2008 Standards in Climate Zone 6.

Small Single Family House

Energy Efficiency Measures
R-38 Roof w/ Radiant Barrier
R-13 Walls
R-0 Slab on Grade
R-30 Raised Floor over Garage/Open at 2nd Floor
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
Furnace: 80% AFUE
Air Conditioner: None
R-8 Attic Ducts
50 Gallon Gas Water Heater: EF=0.62

- 2,025 square feet
- 2-story
- 20.2% glazing/floor area ratio

Large Single Family House

Energy Efficiency Measures
R-19 Roof w/o Radiant Barrier
R-13 Walls
R-19 Raised Floor
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(2) Furnaces: 80% AFUE
Air Conditioner: None
R-4.2 Attic Ducts
(2) Instantaneous Gas Water Heater: RE=0.80

- 4,500 square feet
- 2-story
- 22.0% glazing/floor area ratio

Low-rise Multi-family Apartments

Energy Efficiency Measures
R-19 Roof w/ Radiant Barrier
R-13 Walls
R-0 Slab on Grade
Low E Vinyl Windows, U=0.40, SHGC=0.36
(8) Furnaces: 80% AFUE
Air Conditioners: None
R-4.2 Attic Ducts
(8) 40 Gallon Gas Water Heaters: EF=0.60

- 8,442 square feet
- 8 units/2-story
- 12.5% glazing/floor area ratio

High-rise Multifamily Apartments

Title 24 Base Case Design for Options 1 & 2

Energy Efficiency Measures to Meet Title 24
R-26 (4") rigid insulation; Cool Roof Reflectance=0.30, Emittance=0.75
R-19 in Metal Frame Walls
R-4 (1.25") Raised Slab over parking garage
Metal Windows, NFRC U=0.66, SHGC=0.39
PTC 1-ton units: COP=3, EER=11.1
Central DHW boiler: 95% AFUE and recirculating system w/ timer-temperature controls

- 36,800 sf,
- 40 units
- 4-story
- Window to Wall Ratio = 35.2%

Title 24 Base Case Design for Option 3

Energy Efficiency Measures to Meet Title 24
R-26 (4") rigid insulation; No Cool Roof
R-19 in Metal Frame Walls
R-2 (5/8") Raised Slab over parking garage
Default Dual Metal Windows, U=0.79, SHGC=0.70
2-pipe fan coil, 80% AFUE boiler, no cooling
Central DHW boiler: 80% AFUE and recirculating system w/ timer-temperature controls

Low-rise Office Building

Title 24 Base Case Design, Options 1 and 2

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Dual metal glazing U=0.71 and SHGCc=0.52, 3' overhangs
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56 2-lamp T8 fixtures, mandatory (on/off) ocupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; 80% AFUE furnaces; all standard efficiency fan motors
R-8 duct insulation w/ ducts on the roof
Standard 50 gallon gas water heater, EF=0.58

- Single Story
- 10,580 sf,
- Window to Wall Ratio = 37.1%

Title 24 Base Case Design, Option 3

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Dual metal glazing U=0.71 and SHGCc=0.52, 3' overhangs
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56 2-lamp T8 fixtures, mandatory (on/off) ocupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.
(8) 5-ton Packaged DX units SEER=13.0, 2,000 cfm; 93% AFUE furnaces; all standard efficiency fan motors
R-8 duct insulation w/ ducts on the roof
Standard 50 gallon gas water heater, EF=0.58

High-rise Office Building

Title 24 Base Case Design, Option 1

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Deck; cool roof Reflect=0.55, Emittance=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
NFRC glazing U=0.57, SHGC=0.407 (COG SHGC=0.38)
Lighting = 0.802 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level ocupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; standard efficiency fan motors; 20% VAV boxes w/ electric reheat; DDC controls; differential temp. integrated air economizers
R-8 duct insulation w/ ducts in conditioned
(5) Instantaneous Electric Water Heaters EF=0.92

- 5-story
- 52,900 sf,
- Window to Wall Ratio = 29.1%

Title 24 Base Case Design, Option 2

Energy Efficiency Measures to Meet Title 24
R-19 on Metal Deck; cool roof Reflect=0.55, Emittance=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
NFRC glazing U=0.57, SHGC=0.407 (COG SHGC=0.38)
Lighting = 0.802 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level ocupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; standard efficiency fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers
R-8 duct insulation w/ ducts in conditioned
(5) Instantaneous Electric Water Heaters EF=0.92

Title 24 Base Case Design, Option 3

Energy Efficiency Measures to Meet Title 24
R-26 on Metal Deck, no cool roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
NFRC glazing U=0.57, SHGC=0.544 (COG SHGC=0.54)
Lighting = 0.802 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, mandatory (on/off) ocupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.
Built-up VAV system, 80% boiler, 180-ton screw chiller 1.2 kw/ton, one AHU per floor, standard efficiency VSD fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers
R-8 duct insulation w/ ducts in conditioned
(5) Instantaneous Electric Water Heaters EF=0.92

3.0 Incremental Cost to Exceed 2008 Standards by 15%

The following tables list the energy features and/or equipment included in the 2008 Standards base design, the efficient measure options, and an estimate of the incremental cost for each measure included **to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design**.

Small Single Family House

- 2,025 square feet
- 2-story
- 20.2% glazing/floor area ratio

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,025 SF, Option 1 **2025 sf** **Climate Zone 6**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-13): 2,550 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,148	$ 1,785	$ 1,466
R-0 Slab on Grade	-	$ -	$ -	$ -
R-19 Raised Floor over Garage/Open at 2nd Floor (from R-30): 448 sf @ $0.25 to $0.35/sf	Downgrade	$ (157)	$ (112)	$ (134)
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-8 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 300	$ 600	$ 450
50 Gallon Gas Water Heater: EF=0.62	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,291**	**$ 2,273**	**$ 1,782**
Total Incremental Cost per Square Foot:		**$ 0.64**	**$ 1.12**	**$ 0.88**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,025 SF, Option 2 **2025 sf** **Climate Zone 6**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier (from R-38 w/Radiant Barrier): 1,443 sf @ 0.30 to 0.45/sf	Downgrade	$ (649)	$ (433)	$ (541)
R-19 Walls (from R-13): 2,550 sf @ $0.31 to $0.54/sf	Upgrade	$ 791	$ 1,377	$ 1,084
R-0 Slab on Grade	-	$ -	$ -	$ -
R-19 Raised Floor over Garage/Open at 2nd Floor (from R-30): 448 sf @ $0.25 to $0.35/sf	Downgrade	$ (157)	$ (112)	$ (134)
Quality Insulation Installation (HERS)	Upgrade	$ 450	$ 600	$ 525
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-8)	Downgrade	$ (325)	$ (225)	$ (275)
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 300	$ 600	$ 450
50 Gallon Gas Water Heater: EF=0.62	-	$ -	$ -	$ -
Pipe Insulation	Upgrade	$ 150	$ 200	$ 175
Total Incremental Cost of Energy Efficiency Measures:		**$ 559**	**$ 2,007**	**$ 1,283**
Total Incremental Cost per Square Foot:		**$ 0.28**	**$ 0.99**	**$ 0.63**

Large Single Family House

- 4,500 square feet
- 2-story
- 22.0% glazing/floor area ratio

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 4,500 SF, Option 1 **4500 sf** **Climate Zone 6**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-19 w/o Radiant Barrier): 2,700 sf @ 0.50 to 0.65/sf	Upgrade	$ 1,350	$ 1,755	$ 1,553
R-13 Walls	-	$ -	$ -	$ -
R-19 Raised Floor	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-4.2)	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 600	$ 1,200	$ 900
(2) Instantaneous Gas Water Heater: RE=0.80	-	$ -	$ -	$ -
Pipe Insulation (1705 sf house)	Upgrade	$ 300	$ 400	$ 350
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,250**	**$ 3,355**	**$ 2,803**
Total Incremental Cost per Square Foot:		**$ 0.50**	**$ 0.75**	**$ 0.62**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 4,500 SF, Option 2 **4500 sf** **Climate Zone 6**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-19 w/o Radiant Barrier): 2,700 sf @ 0.50 to 0.65/sf	Upgrade	$ 1,350	$ 1,755	$ 1,553
R-15 Walls (from R-13): 2,518 sf @ $0.14 to $0.18/sf	Upgrade	$ 353	$ 453	$ 403
R-19 Raised Floor	-	$ -	$ -	$ -
Quality Insulation Installation (HERS)	Upgrade	$ 450	$ 600	$ 525
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-4.2 Attic Ducts	-	$ -	$ -	$ -
(2) Instantaneous Gas Water Heater: RE=0.80	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,153**	**$ 2,808**	**$ 2,480**
Total Incremental Cost per Square Foot:		**$ 0.48**	**$ 0.62**	**$ 0.55**

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 4,500 SF, Option 3 **4500 sf** **Climate Zone 6**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier (from R-19 w/o Radiant Barrier): 2,700 sf @ 0.25 to 0.30/sf	Upgrade	$ 675	$ 810	$ 743
R-21 Walls (from R-13): 2,518 sf @ $0.45 to $0.50/sf	Upgrade	$ 1,133	$ 1,259	$ 1,196
R-19 Raised Floor	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-4.2 Attic Ducts	-	$ -	$ -	$ -
(2) Instantaneous Gas Water Heater: RE=0.82 (from 0.80)	Upgrade	$ 400	$ 600	$ 500
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,208**	**$ 2,669**	**$ 2,439**
Total Incremental Cost per Square Foot:		**$ 0.49**	**$ 0.59**	**$ 0.54**

Low-rise Multi-family Apartments

- 8,442 square feet
- 8 units/2-story
- 12.5% glazing/floor area ratio

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 8,442 SF, Option 1 **8442 sf** **Climate Zone 6**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier (from R-19 w/Radiant Barrier): 4,221 sf @ 0.25 to 0.35/sf	Upgrade	$ 1,055	$ 1,477	$ 1,266
R-21 Walls (from R-13): 10,146 sf @ $0.45 to $0.70/sf	Upgrade	$ 4,566	$ 7,102	$ 5,834
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E Vinyl Windows, U=0.40, SHGC=0.36	-	$ -	$ -	$ -
(8) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioners: None	-	$ -	$ -	$ -
R-8 Attic Ducts (from R-4.2)	Upgrade	$ 2,000	$ 3,000	$ 2,500
(8) 40 Gallon Gas Water Heaters: EF=0.63 (from EF=0.60)	Upgrade	$ 800	$ 2,000	$ 1,400
Total Incremental Cost of Energy Efficiency Measures:		**$ 8,421**	**$ 13,580**	**$ 11,000**
Total Incremental Cost per Square Foot:		**$ 1.00**	**$ 1.61**	**$ 1.30**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 8,442 SF, Option 2 **8442 sf** **Climate Zone 6**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-13 Walls	-	$ -	$ -	$ -
R-0 Slab on Grade	-	$ -	$ -	$ -
Dual Clear Vinyl Windows, U=0.50, SHGC=0.60 (from Low E, U=0.40, SHGC=0.36): 1,055 sf @ $1.40 - $1.75 / sf	Downgrade	$ (1,846)	$ (1,477)	$ (1,662)
(8) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioners: None	-	$ -	$ -	$ -
R-4.2 Attic Ducts	-	$ -	$ -	$ -
(8) Instantaneous Gas Water Heaters: EF=0.79 (from (8) 40 Gallon Gas, 0.60 EF)	Upgrade	$ 7,600	$ 13,600	$ 10,600
Total Incremental Cost of Energy Efficiency Measures:		**$ 5,754**	**$ 12,123**	**$ 8,938**
Total Incremental Cost per Square Foot:		**$ 0.68**	**$ 1.44**	**$ 1.06**

High-rise Multifamily Apartments

- 36,800 sf,
- 40 units/4-story
- Window to Wall Ratio = 35.2%

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 1 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 (4") rigid insulation; No Cool Roof, 9,200 sf @$0.30 - $0.40 sf	Downgrade	$ (3,174)	$ (4,232)	$ (3,703)
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	$ -	$ -	$ -
Metal Windows, NFRC U=0.71, SHGCc=0.27; 6,240 sf @ $0.10 to $0.35/sf	Upgrade	$ 920	$ 3,220	$ 2,070
PTC 1-ton units: COP=3, EER=11.1	-	$ -	$ -	$ -
Central DHW boiler: 95% AFUE and recirculating system w/ timer-temperature controls	-	$ -	$ -	$ -
Solar Hot Water System, 30% Net Solar Fraction	Upgrade	$ 40,000	$ 55,000	$ 47,500
Total Incremental Cost of Energy Efficiency Measures:		**$ 37,746**	**$ 53,988**	**$ 45,867**
Total Incremental Cost per Square Foot:		**$ 1.03**	**$ 1.47**	**$ 1.25**

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 2 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 (4") rigid insulation; Cool Roof Refl=0.55, Emitt=0.75 9,200 sf @$0.15 - $0.20 sf	Upgrade	$ 1,380	$ 1,840	$ 1,610
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-6 (2" K-13 spray-on) Raised Slab over parking garage 9,200 sf @0.70 to $1.00 sf	Upgrade	$ 6,440	$ 9,200	$ 7,820
Vinyl Super Low-E, NFRC U=0.39, SHGCc=0.23; 6,240 sf @ $1.40 to $1.60/sf	Upgrade	$ 8,736	$ 9,984	$ 9,360
PTC 1-ton units: COP=3, EER=11.1	-	$ -	$ -	$ -
Central DHW boiler: 95% AFUE and recirculating system w/ timer-temperature controls	-	$ -	$ -	$ -
Solar Hot Water System, 5% Net Solar Fraction	Upgrade	$ 8,000	$ 10,000	$ 9,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 24,556**	**$ 31,024**	**$ 27,790**
Total Incremental Cost per Square Foot:		**$ 0.67**	**$ 0.84**	**$ 0.76**

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 3 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 (4") rigid insulation; No Cool Roof	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-6 (2" K-13 spray-on) Raised Slab over parking garage 9,200 sf @0.70 to $1.00 sf	-	$ -	$ -	$ -
Metal Low-E, NFRC U=0.66, SHGC=0.39; 6,240 sf @ $5.00 to $8.00/sf	Upgrade	$ 31,200	$ 49,920	$ 40,560
PTC 1-ton units: COP=3, EER=11.1	-	$ -	$ -	$ -
Central DHW boiler: 95% AFUE and recirculating system w/ timer-temperature controls	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 31,200**	**$ 49,920**	**$ 40,560**
Total Incremental Cost per Square Foot:		**$ 0.85**	**$ 1.36**	**$ 1.10**

Low-rise Office Building

- Single Story
- 10,580 sf,
- Window to Wall Ratio = 37.1%

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 10,580 SF, Option 1 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Dual metal glazing U=0.71 and SHGCc=0.27, 3' overhangs 3,200 sf @ $2.50 to $3.50/sf	Upgrade	$ 8,000	$ 11,200	$ 9,600
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56 2-lamp T8 fixtures, mandatory (on/off) ocupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	-	$ -	$ -	$ -
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; 80% AFUE furnaces; all standard efficiency fan motors	-	$ -	$ -	$ -
R-8 duct insulation w/ ducts on roof: sealed w/ HERS testing	Upgrade	$ 2,000	$ 3,000	$ 2,500
Standard 50 gallon gas water heater, EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 10,000**	**$ 14,200**	**$ 12,100**
Total Incremental Cost per Square Foot:		**$ 0.95**	**$ 1.34**	**$ 1.14**

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 10,580 SF, Option 2 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-24 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Dual metal glazing U=0.71 and SHGCc=0.27, 3' overhangs 3,200 sf @ $2.50 to $3.50/sf	Upgrade	$ 8,000	$ 11,200	$ 9,600
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56) 2-lamp T8 fixtures, (28) multi-level ocupancy sensors @ $75 to $100 each; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	Upgrade	$ 2,100	$ 2,800	$ 2,450
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; 80% AFUE furnaces; all standard efficiency fan motors	-	$ -	$ -	$ -
R-8 duct insulation w/ ducts on the roof	-	$ -	$ -	$ -
Standard 50 gallon gas water heater, EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 10,100**	**$ 14,000**	**$ 12,050**
Total Incremental Cost per Square Foot:		**$ 0.95**	**$ 1.32**	**$ 1.14**

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 10,580 SF, Option 3 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-24 on Metal Span Deck, Cool Roof Refl.=0.69, Emitt=0.75	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Dual metal glazing U=0.71 and SHGCc=0.40, 3' overhangs 3,200 sf @ $1.50 to $2.50/sf	Upgrade	$ 4,800	$ 8,000	$ 6,400
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; no lighting controls; (24) 18w recessed CFLs. Small Offices: (56) 2-lamp T8 fixtures, mandatory (on/off) occupancy sensors; (40) 18w recessed CFLs. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	-	$ -	$ -	$ -
(8) 5-ton Packaged DX units SEER=13.0, 2,000 cfm; 93% AFUE furnaces; fixed-temp integrated air-economizers	-	$ 3,600	$ 4,800	$ 4,200
R-8 duct insulation w/ ducts on roof: sealed w/ HERS testing	Upgrade	$ 2,000	$ 3,000	$ 2,500
Standard 50 gallon gas water heater, EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 10,400**	**$ 15,800**	**$ 13,100**
Total Incremental Cost per Square Foot:		**$ 0.98**	**$ 1.49**	**$ 1.24**

High-rise Office Building

- 5-story
- 52,900 sf,
- Window to Wall Ratio = 29.1%

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 1 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 on Metal Deck; cool roof Reflect=0.70, Emittance=0.75 10,580 sf @ $0.90 to $1.60/sf	Upgrade	$ 9,522	$ 16,928	$ 13,225
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
NFRC glazing U=0.573, SHGC=0.312 (COG SHGC=0.27) 16,000 sf @ $1.00 to $2.00/sf	Upgrade	$ 16,000	$ 32,000	$ 24,000
Lighting = 0.696 w/sf: Open Office Areas: (160) HO 2-lamp T8 fixtures @74w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level ocupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls. Net saving of $36 to $40 per new fixture in open offices because of a total reduction of 46% of T8 fixtures in these areas	Upgrade	$ (5,760)	$ (6,400)	$ (6,080)
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; Premium efficiency fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers	Upgrade	$ 54,400	$ 81,350	$ 67,875
R-8 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
92% RE boiler for service hot water	Upgrade	$ 8,000	$ 12,000	$ 10,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 82,162**	**$135,878**	**$109,020**
Total Incremental Cost per Square Foot:		**$ 1.55**	**$ 2.57**	**$ 2.06**

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 2 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 on Metal Deck; cool roof Reflect=0.72, Emittance=0.75 10,580 sf @ $0.90 to $1.60/sf	Upgrade	$ 9,522	$ 16,928	$ 13,225
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
NFRC glazing U=0.54, SHGC=0.30 (COG SHGC=0.27) 16,000 sf @ $3.00 to $4.00/sf	Upgrade	$ 48,000	$ 64,000	$ 56,000
Lighting = 0.696 w/sf: Open Office Areas: (160) HO 2-lamp T8 fixtures @74w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level occupancy sensors on T8s; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls. Net saving of $38 to $42 per new fixture in open offices because of a total reduction of 46% of T8 fixtures in these areas	Upgrade	$ (5,760)	$ (6,400)	$ (6,080)
(5) 40-ton Packaged VAV units EER=9.5; 78% TE furnaces; Premium efficiency fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers	Upgrade	$ 1,500	$ 2,500	$ 2,000
R-8 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
92% RE boiler for service hot water	Upgrade	$ 8,000	$ 12,000	$ 10,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 61,262**	**$ 89,028**	**$ 75,145**
Total Incremental Cost per Square Foot:		**$ 1.16**	**$ 1.68**	**$ 1.42**

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 3 **Climate Zone 6**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-26 on Metal Deck, no cool roof	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
NFRC glazing U=0.57, SHGC=0.312 (COG SHGC=0.27) 16,000 sf @ $1.50 to $2.50/sf	Upgrade	$ 24,000	$ 40,000	$ 32,000
Lighting = 0.797 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs. Small Offices: (280) 2-lamp T8 fixtures, (140) multi-level occupancy sensors on T8s @ $75 to $100 each; (200) 18w recessed CFLs. Support Areas: (160) 18w recessed CFLs; (240) 13w CFL wall sconces; no controls.	Upgrade	$ 10,500	$ 14,000	$ 12,250
Built-up VAV system, 80% boiler, 180-ton screw chiller 1.2 kw/ton, one AHU per floor, standard efficiency VSD fan motors; 20% VAV boxes w/ hot water reheat; DDC controls; differential temp. integrated air economizers	-	$ -	$ -	$ -
R-8 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
DHW from 80% RE boiler used for space heating	Upgrade	$ 6,000	$ 10,000	$ 8,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 40,500**	**$ 64,000**	**$ 52,250**
Total Incremental Cost per Square Foot:		**$ 0.77**	**$ 1.21**	**$ 0.99**

5.0 Cost Effectiveness Determination

Regardless of the building design, occupancy profile and number of stories, the incremental improvement in overall annual energy performance of buildings in exceeding the 2008 Standards is determined to be cost-effective. However, each building's overall design, occupancy type and specific design choices may allow for a large range of incremental costs for exceeding 2008 Standards, estimated annual energy cost savings, and subsequent payback period.

Small Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
2,025 sf (Option 1)	87	49	$1,782	$60	29.8
2,025 sf (Option 2)	81	50	$1,283	$60	21.4
Averages:	84	50	$1,533	$60	25.6

Annual Reduction in CO2-equivalent: ***618 lb./building-year***
0.30 lb./sq.ft.-year

Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
4,500 sf (Option 1)	194	44	$2,803	$72	38.8
4,500 sf (Option 2)	207	43	$2,481	$73	33.8
4,500 sf (Option 3)	189	45	$2,439	$72	33.7
Averages:	197	44	$2,574	$73	35.4

Annual Reduction in CO2-equivalent: ***601 lb./building-year***
0.13 lb./sq.ft.-year

Low-rise Multi-family Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
8-Unit, 8,442 sf (Option 1)	470	227	$11,001	$288	38.2
8-Unit, 8,442 sf (Option 2)	-1221	483	$8,939	$260	34.4
Averages:	-376	355	$9,970	$274	36.3

Annual Reduction in CO2-equivalent: ***3,963 lb./building-year***
0.47 lb./sq.ft.-year

High-rise Multi-family Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
36,800 sf (Option 1)	1655	1110	$45,867	$1,307	35.1
36,800 sf (Option 2)	4800	555	$27,790	$1,285	21.6
36,800 sf (Option 3)	27657	-658	$40,560	$3,779	10.7
Averages:	11371	336	$38,072	$2,123	22.5

Annual Reduction in CO2-equivalent: ***11143 lb./building-year***
0.30 lb./sq.ft.-year

Low-rise Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
10,580 sf (Option 1)	13427	-53	$12,100	$2,957	4.1
10,580 sf (Option 2)	5481	356	$12,050	$1,400	8.6
10,580 sf (Option 3)	12307	17	$13,100	$1,026	12.8
Averages:	10405	107	$12,417	$1,794	8.5

Annual Reduction in CO2-equivalent: ***5,924 lb./building-year***
0.56 lb./sq.ft.-year

High-rise Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
52,900 sf (Option 1)	87180	-3439	$109,020	$17,289	6.3
52,900 sf (Option 2)	75234	-2433	$75,145	$15,720	4.8
52,900 sf (Option 3)	99931	-2733	$52,250	$21,244	2.5
Averages:	87448	-2868	$78,805	$18,084	4.5

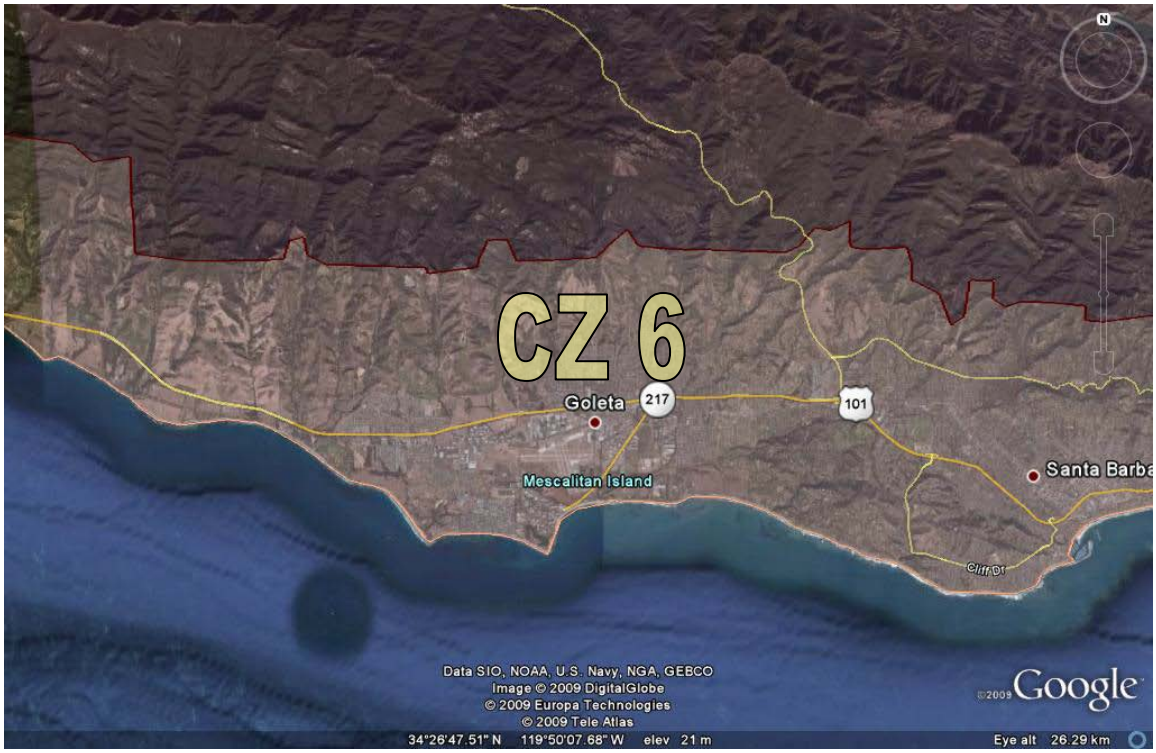
Annual Reduction in CO2-equivalent: ***5,964 lb./building-year***
0.11 lb./sq.ft.-year

Appendix "A"

Climate Zone 6 Cities

1	Agoura Hills	31	Malibu
2	Aliso Viejo	32	Manhattan Beach
3	Calabasas	33	Marina del Rey
4	Camarillo	34	Mission Viejo
5	Capistrano Beach	35	Moorpark
6	Carpinteria	36	Newport Beach
7	Carson	37	Ojai
8	Corona del Mar	38	Oxnard
9	Costa Mesa	39	Pacific Palisades
10	Culver City	40	Palos Verdes Peninsula
11	Dana Point	41	Port Hueneme
12	El Segundo	42	Rancho Palos Verdes
13	Fountain Valley	43	Redondo Beach
14	Garden Grove	44	San Clemente
15	Gardena	45	San Juan Capistrano
16	Goleta	46	Santa Ana
17	Hawthorne	47	Santa Barbara
18	Hermosa Beach	48	Santa Monica
19	Huntington Beach	49	Santa Paula
20	Inglewood	50	Seal Beach
21	Irvine	51	Signal Hill
22	Laguna Beach	52	Somis
23	Laguna Hills	53	Stanton
24	Laguna Niguel	54	Summerland
25	Laguna Woods	55	Sunset Beach
26	Lawndale	56	Surfside
27	Lomita	57	Torrance
28	Lompoc	58	Ventura
29	Long Beach	59	Westlake Village
30	Los Alamitos	60	Westminster

Only a portion located within Climate Zone 6


CZ 6
Goleta
217
101
Mescalitan Island
Santa Barba
Cliff Dr
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2009 DigitalGlobe
© 2009 Europa Technologies
© 2009 Tele Atlas
34°26'47.51" N 119°50'07.68" W elev 21 m
Eye alt 26.29 km
Google


Santa Barbara
E Valley Rd
Foothill Rd
N Ventura Ave
CZ 6
Pacific Coast Hwy
Old Hwy
101
Ventura
Image © 2009 DigitalGlobe
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image U.S. Geological Survey
© 2009 Tele Atlas
34°22'39.47" N 119°27'57.68" W elev 33 m
Eye alt 40.47 km
Google


CZ 6
Ventura
Oxnard
Port Hueneme
Camarillo
101
34
06
Santa Paula Fwy
Ventura Fwy
E Los Angeles Ave
Pacific Coast Hwy
E 5th St
5th St
Image © 2009 City of Thousand Oaks
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image U.S. Geological Survey
© 2009 Tele Atlas
34°13'08.59" N 119°08'59.25" W elev 21 m
Eye alt 34.06 km
Google


CZ 6
Camarillo
Thousand Oaks
Oak Park
Agoura Hills
Westlake Village
34
06
E 5th St
5th St
Ventura Fwy
S Westlake Blvd
Pacific Coast Hwy
Malibu
Image © 2009 City of Thousand Oaks
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image U.S. Geological Survey
© 2009 Tele Atlas
34°07'13.91" N 118°55'45.12" W elev 726 m
Eye alt 34.06 km
Google


CZ 6
Las Flores
Malibu
Santa Monica
Santa Monica Blvd
Santa Monica Fwy
Lincoln Blvd
90
W Manchester Ave
Manhattan Beach
Image © 2009 City of Thousand Oaks
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2009 Europa Technologies
© 2009 Tele Atlas
34°00'05.09" N 118°36'39.09" W elev -72 m
Eye alt 36.50 km
Google


Hawthorne
Manhattan Beach
Lawndale
Gardena
Compton
Paramount
Norwalk
La Mirada
Bellflower
Cerritos
Hermosa Beach
Lakewood
Buena Park
Redondo Beach
Carson
Torrance
Cypress
Stanton
CZ 6
Long Beach
710
22
Rancho Palos Verdes
47
Seal Beach
Westminster
Huntington Beach
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2009 Tele Atlas
33°46'07.35" N 118°12'18.06" W elev 2 m
Eye alt 44.99 km
Google


Fountain Valley
55
Orange
133
Irvine
Huntington Beach
Costa Mesa
CZ 6
Lake Forest
Mission Viejo
Rancho
Newport Beach
Laguna Hills
Aliso Viejo
Laguna Beach
Laguna Niguel
San Juan Capistra
Dana Point
Image © 2009 DigitalGlobe
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2009 Tele Atlas
33°34'47.81" N 117°50'36.63" W elev 68 m
Eye alt 44.99 km
Google