

**Application for Locally Adopted Energy Standards
by the City of Goleta In Accordance With
Section 10-106 of the California Code of Regulations,
Title 24, Part 1**

October 27, 2010

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Executive Summary

The Goleta City Council approved local energy efficiency standards at a first hearing of the ordinance on October 19, 2010. The ordinance requires that new residential and nonresidential construction and additions greater than 500 square feet use the performance approach to demonstrate that they exceed the 2008 Building Energy Efficiency Standards by 15%; or, in the case of nonresidential buildings, that a permit applicant may use an alternative Envelope Only or Lighting Only compliance path that requires exceeding the standards by 10% according to prescriptive envelope and lighting metrics.

The cost-effectiveness study for Climate Zone 6 which used as the basis for the Goleta City Council adoption of the ordinance is one of the climate zone reports prepared by Gabel Associates and funded by Southern California Edison Company in support of local reach codes. The Climate Zone 6 study is included as part of this application.

Overall Scope of the Ordinance

New ordinance or revision to previous ordinance?	New Ordinance
Projected Effective Date:	January 1, 2011
Green building or stand-alone energy ordinance?	Energy Ordinance Only
Do minimum energy requirements increase after initial effective date?	No
Occupancies covered?	Residential and Nonresidential Buildings
Energy requirements apply to new construction, additions, alterations?	New Construction and Additions > 500 Sq.Ft.
Special or unusual energy requirements?	Yes: Pool/Spa Pumps
Third party verification?	No
Implementation details in the ordinance or in a separate document?	Within the Ordinance

Key Features of the Ordinance By Occupancy Type

Occupancy Type	General Requirements	Minimum Energy Requirement Effective January 1, 2011
Low-rise Residential Buildings:		
New Construction	CAL Green Mandatory Requirements	15% Better-than-Title 24
Additions & Alterations > 500 Sq.Ft.	CAL Green Mandatory Requirements	
Nonresidential and High-rise Residential Buildings:		
New Construction	CAL Green Mandatory Requirements	15% Better-than-Title 24; Prescriptive Envelope Alone 10% > T24; Prescriptive Lighting Alone 10% > T24
Additions & Alterations > 500 Sq.Ft.	CAL Green Mandatory Requirements	

Explanation of Nonresidential Prescriptive Options

The performance requirement used in virtually all new construction reach codes – that is a building which exceeds the 2008 standards by 15% -- is predicated on the use of a combination of different envelope, lighting and mechanical measures in nonresidential buildings to achieve a whole building efficiency level. Hundreds of documented performance runs that Gabel Associates has done using various combinations of energy design features, and the analysis of incremental cost and cost-effectiveness, indicate that a mix of envelope, lighting and mechanical design measures are usually needed to reach the 15% better-than-code threshold.

When a permit applicant has a project for which only Envelope compliance or Lighting Compliance is required to meet the standards, trade-offs between the main components of the building are not possible. In that scenario, a 15% better-than-code requirement is not generally achievable, and rarely achievable using a cost-effective approach. The proposed Goleta ordinance provides an Envelope Only Overall TDV energy prescriptive path which requires reducing envelope-only TDV energy by at least 10%. This metric is reasonable and appropriate as a reach code compliance option given how stringent current Title 24 envelope requirements are, and how difficult it is to significantly reduce TDV energy using only nonresidential envelope measures in a mild coastal climate, and especially in commercial buildings with little or no glazing.

With respect to prescriptive lighting design allowed wattage, 2008 standards already dictate relatively low LPDs for most lighting Area Categories. There has been a serious concern raised by local architects about whether establishing allowed lighting wattages less than 10% below current standards will provide sufficient illumination for certain lighting tasks. Without an in depth study to research this issue further, it seems prudent to set the bar for prescriptive lighting alone within the ordinance at 10% below the prescriptive Allowed LPD in the 2008 standards.

It is worth noting that many reach codes simply ignore nonresidential scenarios in which envelope-only, lighting-only or mechanical-only compliance is submitted under separate permits. The approach that the Goleta ordinance takes is to require that all new construction including additions greater than 500 square feet exceed current prescriptive standards by what are, within those metrics, fairly aggressive energy efficiency measures.

Text of the Goleta Ordinance

Approved by a unanimous vote of the Goleta City Council Tuesday, October 19, 2010:

ORDINANCE NO. _____

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF GOLETA ADDING CHAPTER 15.13 OF TITLE 15 OF THE GOLETA MUNICIPAL CODE ESTABLISHING LOCAL ENERGY EFFICIENCY STANDARDS FOR CERTAIN BUILDINGS AND IMPROVEMENTS COVERED BY THE 2008 CALIFORNIA BUILDING ENERGY EFFICIENCY STANDARDS

WHEREAS, despite moderate summer ambient temperatures in the local area, the City of Goleta is served by an energy system that may experience power outages or power reductions (i.e., “brown-outs”) during peak demand periods; and

WHEREAS, reduction of total and peak energy use as a result of incremental energy conservation measures required by this ordinance will have local and regional benefits in the cost-effective reduction of energy costs for the building owner, additional available system energy capacity, and a reduction in greenhouse gas emissions; and

WHEREAS, modifications to the 2008 California Building Energy Efficiency Standards are therefore reasonably necessary due to local climatic conditions; and

WHEREAS, this ordinance preserves and enhances the environment; in that it sets forth increased minimum energy efficiency standards within the City of Goleta for buildings and improvements covered by the ordinance; and

WHEREAS, 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.”; and

WHEREAS, this ordinance is exempt from CEQA review because it can be seen with certainty that there is no possibility that the ordinance may have a significant effect on the environment; and

WHEREAS, Mike Gabel, Gabel Associates, LLC prepared a report entitled Climate Zone 6 Energy Cost Effectiveness Study dated December 24, 2009 (the “Energy Cost Effectiveness Study”); and

WHEREAS, the Energy Cost Effectiveness Study has studied the cost-effectiveness of the energy efficiency measures contained in this ordinance for the Climate Zones within the City's jurisdiction and concluded that the energy efficiency measures contained in this ordinance are cost-effective.

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

SECTION 1. Recitals.

The foregoing recitals are true and correct.

SECTION 2. Findings.

In reliance upon the Energy Cost Effectiveness Study, 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 3. Chapter 15.13 of Title 15 of the Goleta Municipal Code, titled “_Energy Efficiency Standards”, is hereby enacted to read as follows:

Chapter 15.13 Energy Efficiency Standards

15.13.010 Purpose.

This Chapter (“Energy Efficiency Standards”) sets forth increased minimum energy efficiency standards within the City of Goleta for all new construction of any size, additions to existing buildings or structures over a certain size threshold, the installation of certain lighting improvements and the installation of new heaters or circulation pumps for swimming pools, spas and water features. 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.

15.13.020 Definitions.

For purposes of this Chapter 15.13, 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, the following words and phrases shall have the meanings indicated, unless context or usage clearly requires a different meaning:

2008 BUILDING ENERGY EFFICIENCY STANDARDS. The standards and regulations adopted by the California Energy Commission contained in Parts 1 and 6 of Title 24 of the California Code of Regulations as such standards and regulations may be amended from time to time.

EXISTING + ADDITION + ALTERATION. An approach to modeling the TDV (time dependent valuation) energy use of an addition including the existing building and alterations as specified in the Residential Compliance Manual and Nonresidential Compliance Manual.

NONRESIDENTIAL COMPLIANCE MANUAL. The manual developed by the California Energy Commission, under Section 25402.1(e) of the Public Resources Code, to aid designers, builders, and contractors in meeting the requirements of the state's 2008 Building Energy Efficiency Standards for nonresidential, high-rise residential, and hotel/motel buildings.

RESIDENTIAL COMPLIANCE MANUAL. The manual developed by the California Energy Commission, under Section 25402.1(e) of the Public Resources Code, to aid designers, builders, and contractors in meeting the requirements of the state's 2008 Building Energy Efficiency Standards for low-rise residential buildings.

SWIMMING POOL. Any structure intended to contain water over 18 inches deep.

TIME DEPENDENT VALUATION ENERGY or ("TDV ENERGY"). 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).

WATER FEATURE. Any structure intended to contain water over 18 inches deep. Examples of water features include, but are not limited to, ponds and fountains.

15.13.030 Applicability.

A. The provisions of this Chapter apply to any of the following buildings or improvements to the extent that a building permit is required by this Code:

1. Any new building or structure of any size,
2. Any addition to an existing building or structure where the addition is greater than 500 square feet of conditioned floor area,
3. Indoor lighting alterations in conditioned spaces greater than 500 square feet of floor area within nonresidential buildings,

4. All new circulation pumps for swimming pools, spas, and water features.

B. Subject to the limitations specified in this Section, the coverage of this Chapter shall be determined in accordance with the scope and application section of either the Residential Compliance Manual or Nonresidential Compliance Manual, as appropriate for the proposed occupancy.

15.13.040 Compliance.

A building permit application subject to the requirements of this Chapter shall not be issued a building permit by the Building Official unless energy compliance documentation is submitted which satisfies the requirements of this Chapter. A final inspection for a building permit subject to the requirements of this Chapter shall not be approved unless the work authorized by the building permit has been constructed in accordance with the approved plans, conditions of approvals, and requirements of this Chapter.

15.13.050 Mandatory Energy Efficiency Requirements.

In addition to meeting all requirements of 2008 Building Energy Efficiency Standards, all applications for building permits that include 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:

A. **RESIDENTIAL BUILDINGS.** Any built-in appliance (excluding HVAC equipment and water heaters) to be installed in a residential building shall be Energy Star rated, if the appliance installed is of a type that is Energy Star rated and the appliance is not listed with minimum efficiency requirements in the latest edition of the National Appliance Energy Conservation Act (NAECA.)

B. **SWIMMING POOL AND SPA HEATER PUMPS.** Any circulation pump to be installed for any swimming pool, spa, or water feature for which a permit is required by this code shall incorporate the following energy conservation feature:

1. All circulating pump motors and filtration pump motors with a nominal rating of 0.75 horsepower or greater (except pump motors only serving spa jets) shall be two-speed or variable speed motors. The installation of all two-speed and variable speed motors shall include the installation of a controller which shall be time-based and shall be programmed to alternate the speed of the motor between low and high to make effective use of the energy savings potential of the unit's multi-speed capability.

15.13.060 General Compliance Requirements.

In addition to any applicable mandatory requirements specified in Section 22.82.050 and the requirements of the 2008 Building Energy Efficiency Standards, the following general compliance requirements shall apply to permit applications subject to this Chapter as follows:

A. **RESIDENTIAL.** Applications for building permits that involve new residential buildings or additions to existing residential buildings where the additions are greater than 500 square feet of conditioned floor area shall demonstrate compliance with the general compliance requirements as follows:

1. **New Residential Buildings.** When an application for a building permit involves a new residential building, the performance approach specified in Section 151 of the 2008 Building Energy Efficiency Standards must be used to demonstrate that the TDV Energy of the proposed building is at least 15.0% less than the TDV Energy of the standard building.

2. **Additions to Residential Buildings.** When an application for a building permit involves an addition to an existing residential building, this general compliance requirement may be met by either of the following methods:

a. Using the performance approach specified in Section 151 of the 2008 Building Energy Efficiency Standards to demonstrate that the TDV Energy of the proposed addition is at least 15.0% less than the TDV Energy of the standard design; or,

b. Using the “Existing+Addition +Alteration” calculation methodology to demonstrate that the TDV Energy of the proposed building is at least 15.0% less than the TDV Energy of the standard design, as calculated in accordance with the performance approach specified in Section 151 of the 2008 Building Energy Efficiency Standards. In modeling buildings under the Existing+Addition+Alteration method, domestic hot water energy use must be included in the calculation model unless the application does not involve a change to the building’s existing water heater(s).

B. **NONRESIDENTIAL.** Applications for building permits that involve new nonresidential buildings or additions to existing nonresidential buildings where the additions are greater than 500 square feet of conditioned floor area shall demonstrate compliance with the general compliance requirements as follows:

1. **New Nonresidential Buildings.** When an application for a building permit involves a new nonresidential building, meeting the general compliance requirements established by this Chapter may be demonstrated by using either the prescriptive approach or performance approach as specified below:

a. **Prescriptive Approach.** Subject to the exceptions listed below and the provisions of the 2008 Building Energy Efficiency Standards, the prescriptive approach requires compliance with the prescriptive envelope requirement and/or the prescriptive indoor lighting requirement, depending upon the work proposed in the permit application, as specified below:

(1) **Prescriptive Envelopment Requirement.** The Overall Envelope TDV Energy Approach in Section 143(b) of the

2008 Building Energy Efficiency Standards shall be used to demonstrate that the Overall TDV energy of the proposed building is at least 10.0% less than the Overall TDV energy of the standard building; and/or,

(2) **Prescriptive Indoor Lighting Requirement.** The “Prescriptive Requirements for Indoor Lighting” contained in Section 146 of the 2008 Building Energy Efficiency Standards that apply to conditioned spaces shall be used to demonstrate that the Adjusted Actual (Installed) Watts are at least 10.0% less than the Total Allowed Watts.

(i) **Tailored Method Exception.** When using the Tailored Method in retail stores to determine compliance with the prescriptive requirements for indoor lighting, Display Lighting watts may be omitted from the above calculation.

(ii) **Small Alterations Exception.** Lighting alterations which encompass a gross conditioned floor area equal to or less than 500 square feet are exempt from the prescriptive indoor lighting requirement.

b. **Performance Approach.** If the applicant chooses the performance approach, the applicant shall select one of the following energy budget calculation methodologies to demonstrate compliance with the general compliance requirements:

(1) Model the building using a state-approved energy compliance software program and demonstrate that the TDV Energy of the proposed building is at least 15.0% less than the TDV Energy of the standard building. In calculating the %-better-than-Title-24, the TDV energy of the Process and Receptacle energy use components is omitted in both the proposed and standard designs.

2. **Additions to Nonresidential Buildings.** When an application for a building permit involves an addition to an existing nonresidential building, the general compliance requirement may be met by either of the following methods:

a. Using the “Addition Alone” performance method to demonstrate that the TDV Energy sum of the energy components for the proposed addition specified in B.1.a(1) above is at least 15.0% less than the TDV Energy sum of the same energy components of the standard addition; or,

b. Using the “Existing+Addition +Alteration” performance method to demonstrate that the TDV Energy sum of the energy components for the proposed building specified in B.1.a(1) above is at least 10.0% less than the TDV Energy sum of the same energy components of the standard design.

D. **DOCUMENTATION.** In order to demonstrate compliance with the requirements of this Section, a permit applicant may be required to submit supplementary forms and documentation in addition to the building drawings, specifications, and standard Title 24 report forms, as deemed appropriate by the Building Official.

SECTION 4. Energy Commission Compliance.

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 5. Severability.

Should any provision, section, paragraph, sentence or work of this Ordinance be rendered or declared invalid by a court of competent jurisdiction or by reason of any preemptive legislation, the remaining provisions, sections, paragraphs, sentences or words of this Ordinance shall remain in full force and effect.

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 take effect on January 1, 2011.

SECTION 8. Certification.

The City Clerk shall certify to the passage and adoption of this Ordinance and shall cause the same to be published or posted according to law.

INTRODUCED ON the ____ day of October, 2010.

PASSED, APPROVED, AND ADOPTED this ____ day of November, 2010.

ERIC ONNEN, MAYOR

ATTEST:

APPROVED AS TO FORM:

DEBORAH CONSTANTINO
CITY CLERK

TIM W. GILES
CITY ATTORNEY

Codes and Standards Title 24 Energy-Efficient Local Ordinances

Title: Climate Zone 6 Energy Cost-Effectiveness Study

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Last Modified: December 24, 2009



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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 CO₂ 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) occupancy 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) 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; 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 occupancy 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 occupancy 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) occupancy 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, SHGC=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) occupancy 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 occupancy 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 SHGC=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 occupancy 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	35	Moorpark
6	Beach	36	Newport Beach
7	Carpinteria	37	Ojai
7	Carson	38	Oxnard
8	Corona del Mar	39	Pacific Palisades
9	Costa Mesa	39	Palos Verdes
10	Culver City	40	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	49	Santa Paula
19	Beach	50	Seal Beach
20	Inglewood	51	Signal Hill
21	Irvine	52	Somis
22	Laguna Beach	53	Stanton
23	Laguna Hills	54	Summerland
24	Laguna Niguel	55	Sunset Beach
25	Laguna Woods	56	Surfside
26	Lawndale	57	Torrance
27	Lomita	58	Ventura
28	Lompoc	59	Westlake Village
29	Long Beach	60	Westminster
30	Los Alamitos		

 Only a portion located within Climate Zone 6







