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

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Climate Zone 3
Energy Cost-Effectiveness Study

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1.0 Executive Summary

This report presents the results of Gabel Associates' research and review of the feasibility and energy cost-effectiveness of building permit applicants exceeding the 2008 Building Energy Efficiency Standards to meet the minimum energy-efficiency requirements of local energy efficiency standards covering Climate Zone 3. A local government may use this report as a basis for demonstrating energy cost-effectiveness of a proposed green building or energy ordinance. The study assumes that such an ordinance requires, for the building categories covered, that building energy performance exceeds the 2008 TDV energy standard budget by at least 15%.

The study is also contained in the local government's application to the California Energy Commission (CEC) which must meet all requirements specified in Section 10-106 of the California Code of Regulations, Title 24, Part 1, Article 1: Locally Adopted Energy Standards. An ordinance shall be legally enforceable (a) after the CEC has reviewed and approved the local energy standards as meeting all requirements of Section 10-106; and (b) the ordinance has been adopted by the local government and filed with the Building Standards Commission.

The 2008 Building Energy Efficiency Standards, which took effect on January 1, 2010, are the baseline used to calculate the cost-effectiveness data.

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 3 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 CO_2-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 Micropas 8, state-approved energy compliance software for the 2008 Building Energy Efficiency Standards.

2. Average residential utility rates of $0.18/kWh for electricity and $1.15/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: PG&E A-6 schedule for electricity and PG&E G-NR1 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 3.

Small Single Family House

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

Energy Efficiency Measures
R-38 Roof w/ Radiant Barrier
R-13 Walls
R-30 Raised Floor over Garage/Open at 2nd Floor
R-0 Slab on Grade
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)
50 Gallon Gas Water Heater: EF=0.62

Large Single Family House

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

Energy Efficiency Measures
R-30 Roof w/ 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-6 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
(2) 50 Gallon Gas Water Heaters: EF=0.61

Low-rise Multi-family Apartments

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

Energy Efficiency Measures
R-30 Roof w/ Radiant Barrier
R-13 Walls
R-0 Slab on Grade
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(8) Furnaces: 80% AFUE
Air Conditioner: None
R-6 Attic Ducts
(8) 40 Gallon Gas Water Heaters: EF=0.63
Pipe Insulation

High-rise Multifamily Apartments

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

Energy Efficiency Measures to Meet Title 24
R-19 under Metal Deck and additional R-11 batt below (no framing); with Cool Roof Reflectance = 0.55, Emittance = 0.75
R-19 in Metal Frame Walls
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage
Dual Metal Windows: default U-factor=0.79, SHGC COG = 0.38
1.5 ton 4-pipe fan coils, 80% AFUE boiler, 70-ton scroll air cooled chiller @ 0.72 KW/ton
Central DHW boiler: 80% AFUE and recirculating system w/ timer-temperature controls

Low-rise Office Building

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

Energy Efficiency Measures to Meet Title 24
R-19 under Metal Deck, no cool roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Metal windows: Default glazing U=0.71, COG SHGC=0.54
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; (24) 18w recessed CFLs no lighting controls. Small Offices: (56) 2-lamp T8 fixtures; (40) 18w recessed CFLs, on/off lighting controls. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.
(3) 10-ton DX units EER=11.0; 80% AFUE furnaces; standard efficiency fan motors; fixed temp. integrated air economizers
R-6 duct insulation w/ ducts on roof
(1) Tank Gas Water Heaters EF=0.58

High-rise Office Building

- 5-story
- 52,900 sf,
- Window to Wall Ratio = 34.5%

Design "A" for Options 1 and 2

Energy Efficiency Measures to Meet Title 24
R-19 under Metal Deck, no cool roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Metal windows: Default glazing U=0.71, SHGC = 0.73
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 58w fixtures on/off lighting controls; (200) 18w recessed CFLs no lighting on/off lighting controls. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.
(3) 60 ton Packaged VAV system 10 EER/80% TE, standard efficiency variable speed fan motors; 20% VAV boxes, electric water reheat on perimeter zones
R-6 duct insulation w/ ducts in conditioned
(1) Tank Gas Water Heaters EF=0.58

Design "B" for Options 3, 4 and 5

Energy Efficiency Measures to Meet Title 24
R-19 under Metal Deck, no cool roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Metal windows: Default glazing U=0.71, SHGC = .73
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 58w fixtures on/off lighting controls; (200) 18w recessed CFLs no lighting on/off lighting controls. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.
(3) 60 ton Packaged VAV system 10 EER/80% TE, standard efficiency variable speed fan motors; 25% VAV boxes, hot water reheat on perimeter zones with 80% AFUE boiler.
R-6 duct insulation w/ ducts in conditioned
DHW 80% AFUE boiler

4.0 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 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-19 Walls (from R-13): 2,550 sf @$0.31 to $0.54/sf	Upgrade	$ 791	$ 1,377	$ 1,084
R-30 Raised Floor over Garage/Open at 2nd Floor	-	$ -	$ -	$ -
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 92% AFUE (from 80% AFUE)	Upgrade	$ 500	$ 1,200	$ 850
Air Conditioner: None	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-8)	Downgrade	$ (325)	$ (225)	$ (275)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
50 Gallon Gas Water Heater: EF=0.62	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 966**	**$ 2,352**	**$ 1,659**
Total Incremental Cost per Square Foot:		**$ 0.48**	**$ 1.16**	**$ 0.82**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,025 SF, Option 2 **2025 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-19 Walls (from R-13): 2,550 sf @$0.31 to $0.54/sf	Upgrade	$ 791	$ 1,377	$ 1,084
R-30 Raised Floor over Garage/Open at 2nd Floor	-	$ -	$ -	$ -
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-4.2 Attic Ducts (from R-8)	Downgrade	$ (650)	$ (450)	$ (550)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
Instantaneous Gas Water Heater: RE=0.80 (from 50 Gal Gas: EF=0.62)	Upgrade	$ 900	$ 1,500	$ 1,200
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,041**	**$ 2,427**	**$ 1,734**
Total Incremental Cost per Square Foot:		**$ 0.51**	**$ 1.20**	**$ 0.86**

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 2,025 SF, Option 3 **2025 sf** **Climate Zone 3**

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-30 Raised Floor over Garage/Open at 2nd Floor	-	$ -	$ -	$ -
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 90% AFUE (from 80% AFUE)	Upgrade	$ 500	$ 1,000	$ 750
Air Conditioner: None	-	$ -	$ -	$ -
R-4.2 Attic Ducts (from R-8)	Downgrade	$ (650)	$ (450)	$ (550)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
50 Gallon Gas Water Heater: EF=0.61 (from EF=0.62)	Downgrade	$ (100)	$ (50)	$ (75)
Total Incremental Cost of Energy Efficiency Measures:		**$ 898**	**$ 2,285**	**$ 1,591**
Total Incremental Cost per Square Foot:		**$ 0.44**	**$ 1.13**	**$ 0.79**

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 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/ Radiant Barrier): 2,700 sf @ 0.15 to 0.20/sf	Upgrade	$ 405	$ 540	$ 473
R-21 Walls (from R-13): 2,518 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,133	$ 1,763	$ 1,448
R-30 Raised Floor (from R-19): 2,700 sf @ $0.25 to $0.35	Upgrade	$ 675	$ 945	$ 810
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-8 Attic Ducts (from R-6)	Upgrade	$ 450	$ 650	$ 550
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) 50 Gallon Gas Water Heaters: EF=0.62 (from EF=0.61)	Upgrade	$ 100	$ 200	$ 150
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,763**	**$ 4,098**	**$ 3,430**
Total Incremental Cost per Square Foot:		**$ 0.61**	**$ 0.91**	**$ 0.76**

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 4,500 SF, Option 2 **4500 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/ Radiant Barrier): 2,700 sf @ 0.15 to 0.20/sf	Upgrade	$ 405	$ 540	$ 473
R-15 Walls (from R-13): 2,518 sf @ $0.14 to $0.18/sf	Upgrade	$ 353	$ 453	$ 403
R-30 Raised Floor (from R-19): 2,700 sf @ $0.25 to $0.35	Upgrade	$ 675	$ 945	$ 810
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 92% AFUE (from 80% AFUE)	Upgrade	$ 1,000	$ 2,400	$ 1,700
Air Conditioner: None	-	$ -	$ -	$ -
R-8 Attic Ducts (from R-6)	Upgrade	$ 450	$ 650	$ 550
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) 50 Gallon Gas Water Heaters: EF=0.63 (from EF=0.61)	Upgrade	$ 100	$ 300	$ 200
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,983**	**$ 5,288**	**$ 4,135**
Total Incremental Cost per Square Foot:		**$ 0.66**	**$ 1.18**	**$ 0.92**

Incremental Cost Estimate to Exceed Title 24 by 15%

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

Energy Efficiency Measures	Change	Incremental Cost Estimate		
R-38 Roof w/ Radiant Barrier (from R-30 w/ Radiant Barrier): 2,700 sf @ 0.15 to 0.20/sf	Upgrade	$ 405	$ 540	$ 473
R-19 Walls (from R-13): 2,518 sf @ $0.31 to $0.54/sf	Upgrade	$ 781	$ 1,360	$ 1,070
R-19 Raised Floor	-	$ -	$ -	$ -
Quality Insulation Installation (HERS)	Upgrade	$ 900	$ 1,200	$ 1,050
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) 50 Gallon Gas Water Heaters: EF=0.63 (from EF=0.61)	Upgrade	$ 100	$ 300	$ 200
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,186**	**$ 3,400**	**$ 2,793**
Total Incremental Cost per Square Foot:		**$ 0.49**	**$ 0.76**	**$ 0.62**

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%

Multi-Family Prototype: 8,442 SF, Option 1 **8442 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
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 E2 Vinyl, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(8) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-4.2 Attic Ducts (from R-6)	Downgrade	$ (1,600)	$ (1,000)	$ (1,300)
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 2,400	$ 4,800	$ 3,600
(8) 40 Gallon Gas Water Heaters: EF=0.63	-	$ -	$ -	$ -
Remove Pipe Insulation	Downgrade	$ (1,600)	$ (1,200)	$ (1,400)
Total Incremental Cost of Energy Efficiency Measures:		**$ 3,766**	**$ 9,702**	**$ 6,734**
Total Incremental Cost per Square Foot:		**$ 0.45**	**$ 1.15**	**$ 0.80**

Incremental Cost Estimate to Exceed Title 24 by 15%

Multi-Family Prototype: 8,442 SF, Option 2 **8442 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 4,221 sf @ 0.15 to 0.20/sf	Upgrade	$ 633	$ 844	$ 739
R-19 Walls (from R-13): 10,146 sf @ $0.31 to $0.54/sf	Upgrade	$ 3,145	$ 5,479	$ 4,312
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E2 Vinyl, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(8) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: None	-	$ -	$ -	$ -
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 2,400	$ 4,800	$ 3,600
(8) 40 Gallon Gas Water Heaters: EF=0.63	-	$ -	$ -	$ -
Remove Pipe Insulation	Downgrade	$ (1,600)	$ (1,200)	$ (1,400)
Total Incremental Cost of Energy Efficiency Measures:		**$ 4,578**	**$ 9,923**	**$ 7,251**
Total Incremental Cost per Square Foot:		**$ 0.54**	**$ 1.18**	**$ 0.86**

Incremental Cost Estimate to Exceed Title 24 by 15%
Multi-Family Prototype: 8,442 SF, Option 3 **8442 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 4,221 sf @ 0.25 to 0.35/sf	Downgrade	$ (1,477)	$ (1,055)	$ (1,266)
R-19 Walls (from R-13): 10,146 sf @ $0.31 to $0.54/sf	Upgrade	$ 3,145	$ 5,479	$ 4,312
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E2 Vinyl, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(8) Furnaces: 90% AFUE (from 80% AFUE)	Upgrade	$ 4,000	$ 8,000	$ 6,000
Air Conditioner: None	-	$ -	$ -	$ -
R-4.2 Attic Ducts (from R-6)	Downgrade	$ (1,600)	$ (1,000)	$ (1,300)
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 2,400	$ 4,800	$ 3,600
(8) 40 Gallon Gas Water Heaters: EF=0.62 (from EF=0.63)	Downgrade	$ (400)	$ -	$ (200)
Remove Pipe Insulation	Downgrade	$ (1,600)	$ (1,200)	$ (1,400)
Total Incremental Cost of Energy Efficiency Measures:		**$ 4,468**	**$ 15,024**	**$ 9,746**
Total Incremental Cost per Square Foot:		**$ 0.53**	**$ 1.78**	**$ 1.15**

High-rise Multifamily Apartments

- 36,800 sf,
- 40 units/4-story
- Window to Wall Ratio = 31.6%

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal Deck **and additional R-30 batt below** (no framing); with Cool Roof Reflectance = 0.55, Emittance = 0.75; 9,200 sf @ $0.30 to $0.40/sf	Upgrade	$ 2,760	$ 3,680	$ 3,220
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	$ -	$ -	$ -
Dual Metal Windows: **COG U-factor=0.3, COG SHGC=0.27** 6,240 sf @ $2.00 to $3.00/sf	Upgrade	$ 12,480	$ 18,720	$ 15,600
1.5 ton 4-pipe fan coil, **98% AFUE** boiler, 60-ton scroll air cooled chiller 0.72 KW/ton (cost of boiler below under DHW)	Upgrade	$ -	$ -	$ -
Central DHW boiler: **98% AFUE** and recirculating system w/ timer-temperature controls	Upgrade	$ 4,000	$ 8,000	$ 6,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 19,240**	**$ 30,400**	**$ 24,820**
Total Incremental Cost per Square Foot:		**$ 0.52**	**$ 0.83**	**$ 0.67**

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 2 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal Deck and additional R-11 batt below (no framing); with no cool roof; 9,200 sf @ $0.35 to $0.50/sf	Downgrade	$ (3,220)	$ (4,600)	$ (3,910)
R-19 in Metal Frame Walls **w/ 1" continuous outside (R-5);** 12,112 sf @ $4.00/sf to $7.00/sf	Upgrade	$ 48,448	$ 84,784	$ 66,616
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	$ -	$ -	$ -
Dual Metal Windows: **COG U-factor=0.3, COG SHGC=0.31** 6,240 sf @ $1.00 to $2.00/sf	Upgrade	$ 6,240	$ 12,480	$ 9,360
1.5 ton 4-pipe fan coil, **98% AFUE** boiler, 60-ton scroll air cooled chiller 0.72 KW/ton (cost of boiler below under DHW)	Upgrade	$ -	$ -	$ -
Central DHW boiler: **98% AFUE** and recirculating system w/ timer-temperature controls	Upgrade	$ 4,000	$ 8,000	$ 6,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 55,468**	**$100,664**	**$ 78,066**
Total Incremental Cost per Square Foot:		**$ 1.51**	**$ 2.74**	**$ 2.12**

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

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal Deck **and additional R-30 batt below** (no framing); with Cool Roof Reflectance = 0.55, Emittance = 0.75; 9,200 sf @ $0.30 to $0.40/sf	Upgrade	$ 2,760	$ 3,680	$ 3,220
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-4 (1.25" K-13 spray-on) Raised Slab over parking garage	-	$ -	$ -	$ -
Dual Metal Windows: **COG U-factor=0.3,** COG SHGC=0.38 6,240 sf @ $0.50 to $1.00/sf	Upgrade	$ 3,120	$ 6,240	$ 4,680
1.5 ton 4-pipe fan coil, **94% AFUE boiler**, 70-ton scroll air cooled chiller 0.72 KW/ton	Upgrade	$ 3,000	$ 6,000	$ 4,500
Central DHW boiler: **94% AFUE** and recirculating system w/ timer-temperature controls **and solar water heating, 25% Net Solar Fraction** (cost of boiler above under space heating boiler)	Upgrade	$ 40,000	$ 55,000	$ 47,500
Total Incremental Cost of Energy Efficiency Measures:		**$ 48,880**	**$ 70,920**	**$ 59,900**
Total Incremental Cost per Square Foot:		**$ 1.33**	**$ 1.93**	**$ 1.63**

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 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate Min	Max	Avg
R-19 under Metal Deck **and additional R-13 batt below (no framing)**; **with Cool Roof Reflectance = 0.55, Emittance = 0.75;** 10,580 sf @ $0.60 to $0.85/sf	Upgrade	$ 6,348	$ 8,993	$ 7,671
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.38;** 3,200 sf @ $1.50 to $2.00/sf	Upgrade	$ 4,800	$ 6,400	$ 5,600
Lighting = 0.783 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; (24) 18w recessed CFLs no lighting controls. Small Offices: (56) 2-lamp T8 fixtures, (40) 18w recessed CFLs: **(28) multi-level ocupancy sensors on T8s and recessed CFLa @ $75 to $100 each**. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	Upgrade	$ 2,100	$ 2,800	$ 2,450
(3) 10-ton DX units EER=11.0; 80% AFUE furnaces; standard efficiency fan motors; fixed temp. integrated air economizers	-	$ -	$ -	$ -
R-6 duct insulation w/ducts on roof, **HERS verified duct leakage**	Upgrade	$ 1,000	$ 1,800	$ 1,400
(1) Tank Gas Water Heaters EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 14,248**	**$ 19,993**	**$ 17,121**
Total Incremental Cost per Square Foot:		**$ 1.35**	**$ 1.89**	**$ 1.62**

Incremental Cost Estimate to Exceed Title 24 by 15%

Nonresidential Prototype: 10,580 SF, Option 2 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate Min	Max	Avg
R-19 under Metal Deck **and additional R-25 batt below (no framing)**; **with Cool Roof Reflectance = 0.55, Emittance = 0.75;** 10,580 sf @ $0.75 to $1.10/sf	Upgrade	$ 7,935	$ 11,638	$ 9,787
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.27;** 3,200 sf @ $2.00 to $3.00/sf	Upgrade	$ 6,400	$ 9,600	$ 8,000
Lighting = 0.858 w/sf: Open Office Areas: (60) 2-lamp T8 fixtures @58w each; (24) 18w recessed CFLs no lighting controls. Small Offices: (56) 2-lamp T8 fixtures; (40) 18w recessed CFLs, on/off lighting controls. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	-	$ -	$ -	$ -
(3) 10-ton DX units EER=11.0; 80% AFUE furnaces; standard efficiency fan motors; fixed temp. integrated air economizers, **Controls to include "Cycle on at night"**	Upgrade	$ 300	$ 600	$ 450
R-6 duct insulation w/ducts on roof, **HERS verified duct leakage**	Upgrade	$ 1,000	$ 1,800	$ 1,400
(1) Tank Gas Water Heaters EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 15,635**	**$ 23,638**	**$ 19,637**
Total Incremental Cost per Square Foot:		**$ 1.48**	**$ 2.23**	**$ 1.86**

Incremental Cost Estimate to Exceed Title 24 by 15%

Nonresidential Prototype: 10,580 SF, Option 3 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-19 under Metal Deck **and additional R-13 batt below (no framing)**; no cool roof; 10,580 sf @ $0.25 to $0.35/sf	Upgrade	$ 2,645	$ 3,703	$ 3,174
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.38;** 3,200 sf @ $1.50 to $2.00/sf	Upgrade	$ 4,800	$ 6,400	$ 5,600
Lighting = 0.746 w/sf: Open Office Areas: **(32) HO 2-lamp T8 fixtures @74w each**; (24) 18w recessed CFLs no lighting controls. Small Offices: (56) 2-lamp T8 fixtures, (40) 18w recessed CFLs: **(28) multi-level ocupancy sensors on T8s and recessed CFLa @ $75 to $100 each**. Support Areas: (32) 18w recessed CFLs; (48) 13w CFL wall sconces; no controls.	Upgrade	$ 820	$ 1,648	$ 1,234
(3) 10-ton DX units EER=11.0; 80% AFUE furnaces; standard efficiency fan motors; fixed temp. integrated air economizers, **Controls to include "Cycle on at night"**	Upgrade	$ 300	$ 600	$ 450
R-6 duct insulation w/ ducts on roof	-			
(1) Tank Gas Water Heaters EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 8,565**	**$ 12,351**	**$ 10,458**
Total Incremental Cost per Square Foot:		**$ 0.81**	**$ 1.17**	**$ 0.99**

High-rise Office Building

- 5-story
- 52,900 sf,
- Window to Wall Ratio = 34.5%

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate Min	Max	Avg
R-19 under Metal Deck wi**th Cool Roof Reflectance = 0.55, Emittance = 0.75;** 10,580 sf @ $0.35 to $0.50/sf	Upgrade	$ 3,703	$ 5,290	$ 4,497
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.38**; 16,000 sf @ $2.00 to $2.50/sf	Upgrade	$ 32,000	$ 40,000	$ 36,000
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 58w fixtures on/off lighting controls; (200) 18w recessed CFLs no lighting on/off lighting controls. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.	-	$ -	$ -	$ -
(3) 60 ton Packaged VAV system 10 EER/80% TE, standard efficiency variable speed fan motors; **15% VAV boxes,** electric water reheat on perimeter zones	Upgrade	$ 26,450	$ 39,675	$ 33,063
R-6 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
(1) Tank Gas Water Heaters EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 62,153**	**$ 84,965**	**$ 73,559**
Total Incremental Cost per Square Foot:		**$ 1.17**	**$ 1.61**	**$ 1.39**

Incremental Cost Estimate to Exceed Title 24 by 15%

Nonresidential Prototype: 52,900 SF, Option 2 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate Min	Max	Avg
R-19 under Metal Deck **and additional R-13 batt below (no framing)**; no cool roof; 10,580 sf @ $0.25 to $0.35/sf	Upgrade	$ 2,645	$ 3,703	$ 3,174
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.54**; 16,000 sf @ $1.50 to $2.00/sf	Upgrade	$ 24,000	$ 32,000	$ 28,000
Lighting = 0.783 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 58w fixtures on/off lighting controls; (200) 18w recessed CFLs **multi-level ocupancy sensors on T8s and recessed CFLs @ $75 to $100 each.** Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.	Upgrade	$ 10,500	$ 14,000	$ 12,250
(3) 60 ton Packaged VAV system 10 EER/80% TE, standard efficiency variable speed fan motors; **15% VAV boxes,** electric water reheat on perimeter zones	Upgrade	$ 26,450	$ 52,900	$ 39,675
R-6 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
(1) Tank Gas Water Heaters EF=0.58	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 63,595**	**$ 102,603**	**$ 83,099**
Total Incremental Cost per Square Foot:		**$ 1.20**	**$ 1.94**	**$ 1.57**

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

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate Min	Max	Avg
R-19 under Metal Deck **and additional R-13 batt below (no framing)**; no cool roof; 10,580 sf @ $0.25 to $0.35/sf	Upgrade	$ 2,645	$ 3,703	$ 3,174
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.54**; 16,000 sf @ $1.50 to $2.00/sf	Upgrade	$ 24,000	$ 32,000	$ 28,000
Lighting = 0.858 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 58w fixtures on/off lighting controls; (200) 18w recessed CFLs no lighting on/off lighting controls. Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.	-	$ -	$ -	$ -
(3) 60 ton Packaged VAV system 10 EER/80% TE, standard efficiency variable speed fan motors; **20% VAV boxes,** hot water reheat on perimeter zones with **92% AFUE boiler** (cost of boiler included below for DHW)	Upgrade	$ 26,450	$ 52,900	$ 39,675
R-6 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
DHW **92% AFUE boiler**	Upgrade	$ 2,000	$ 4,000	$ 3,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 55,095**	**$ 92,603**	**$ 73,849**
Total Incremental Cost per Square Foot:		**$ 1.04**	**$ 1.75**	**$ 1.40**

Incremental Cost Estimate to Exceed Title 24 by 15%

Nonresidential Prototype: 52,900 SF, Option 4 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate Min	Max	Avg
R-19 under Metal Deck **and additional R-13 batt below (no framing)**; **with Cool Roof Reflectance = 0.55, Emittance = 0.75;** 10,580 sf @ $0.60 to $0.85/sf	Upgrade	$ 6,348	$ 8,993	$ 7,671
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.54**; 16,000 sf @ $1.50 to $2.00/sf	Upgrade	$ 24,000	$ 32,000	$ 28,000
Lighting = 0.783 w/sf: Open Office Areas: (300) 2-lamp T8 fixtures @58w each; no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 58w fixtures on/off lighting controls; (200) 18w recessed CFLs **multi-level ocupancy sensors on T8s and recessed CFLs @ $75 to $100 each.** Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.	Upgrade	$ 10,500	$ 14,000	$ 12,250
(3) 60 ton Packaged VAV system 10 EER/80% TE, standard efficiency variable speed fan motors; 25% VAV boxes, hot water reheat on perimeter zones with **92% AFUE boiler** (cost of boiler included below for DHW).	Upgrade	$ -	$ -	$ -
R-6 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
DHW **92% AFUE boiler**	Upgrade	$ 2,000	$ 4,000	$ 3,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 42,848**	**$ 58,993**	**$ 50,921**
Total Incremental Cost per Square Foot:		**$ 0.81**	**$ 1.12**	**$ 0.96**

Incremental Cost Estimate to Exceed Title 24 by 15%

Nonresidential Prototype: 52,900 SF, Option 5 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate Min	Max	Avg
R-19 under Metal Deck **and additional R-13 batt below (no framing)**; **with Cool Roof Reflectance = 0.55, Emittance = 0.75;** 10,580 sf @ $0.60 to $0.85/sf	Upgrade	$ 6,348	$ 8,993	$ 7,671
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor	-	$ -	$ -	$ -
Metal windows: default U=0.71, **COG SHGC=0.54**; 16,000 sf @ $1.50 to $2.00/sf	Upgrade	$ 24,000	$ 32,000	$ 28,000
Lighting = 0.678 w/sf: Open Office Areas: **(160) 2-lamp T8 fixtures @74w each;** no lighting controls; (120) 18w recessed CFLs no lighting controls. Small Offices: (280) 2-lamp T8 58w fixtures on/off lighting controls; (200) 18w recessed CFLs **multi-level ocupancy sensors on T8s and recessed CFLs @ $75 to $100 each.** Support Areas: (160) 18w recessed CFLs no lighting controls; (240) 13w CFL wall sconces; no lighting controls.	Upgrade	$ 10,500	$ 14,000	$ 12,250
(3) 60 ton Packaged VAV system 10 EER/80% TE, standard efficiency variable speed fan motors; 25% VAV boxes, hot water reheat on perimeter zones with **94% AFUE boiler** (cost of boiler included below for DHW).	Upgrade	$ -	$ -	$ -
R-6 duct insulation w/ ducts in conditioned	-	$ -	$ -	$ -
DHW **94% AFUE boiler**	Upgrade	$ 4,000	$ 8,000	$ 6,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 44,848**	**$ 62,993**	**$ 53,921**
Total Incremental Cost per Square Foot:		**$ 0.85**	**$ 1.19**	**$ 1.02**

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)	78	85	$1,659	$112	14.8
2,025 sf (Option 2)	72	87	$1,734	$113	15.3
2,025 sf (Option 3)	85	81	$1,592	$108	14.7
Averages:	78	84	$1,662	$111	15.0

Annual Reduction in CO2-equivalent: 0.50 lb./sq.ft.-year, 1,017 lb./building-year
Increased Cost / lb. CO2-e reduction: $1.63

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)	181	105	$3,431	$153	22.4
4,500 sf (Option 2)	88	117	$4,136	$150	27.5
4,500 sf (Option 3)	172	106	$2,793	$153	18.3
Averages:	147	109	$3,453	$152	22.7

Annual Reduction in CO2-equivalent: 0.30 lb./sq.ft.-year, 1,339 lb./building-year
Increased Cost / lb. CO2-e reduction: $2.58

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)	569	345	$6,734	$499	13.5
8-Unit, 8,442 sf (Option 2)	552	342	$7,251	$493	14.7
8-Unit, 8,442 sf (Option 3)	453	337	$9,746	$469	20.8
8-Unit, 8,442 sf (Option 4)	57	396	$8,323	$466	17.9
Averages:	354	358	$8,440	$476	17.8

Annual Reduction in CO2-equivalent: 0.51 lb./sq.ft.-year, 4,316 lb./building-year
Increased Cost / lb. CO2-e reduction: $1.86

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)	668	1766	$24,820	$2,151	11.5
36,800 sf (Option 2)	-2616	2314	$78,066	$2,190	35.6
36,800 sf (Option 3)	-2519	2811	$51,940	$2,779	18.7
Averages:	-1489	2297	$51,609	$2,374	22.0

Annual Reduction in CO2-equivalent: 0.71 lb./sq.ft.-year, 26,067 lb./building-year
Increased Cost / lb. CO2-e reduction: $1.97

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)	10410	-79	$17,121	$2,765	6.2
10,580 sf (Option 2)	8612	-182	$19,637	$2,247	8.7
10,580 sf (Option 3)	10594	-223	$10,458	$2,475	4.2
Averages:	9872	-161	$15,738	$2,496	6.4

Annual Reduction in CO2-equivalent: 0.24 lb./sq.ft.-year, 2,564 lb./building-year
Increased Cost / lb. CO2-e reduction: $7.17

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)	76452	-16	$73,559	$17,629	4.2
52,900 sf (Option 2)	74762	-3	$83,099	$16,457	5.0
52,900 sf (Option 3)	40583	4523	$73,849	$16,248	4.5
52,900 sf (Option 4)	55173	2217	$50,921	$34,725	1.5
52,900 sf (Option 5)	40996	4871	$53,921	$31,964	1.7
Averages:	57593	2318	$67,070	$23,405	3.4

Annual Reduction in CO2-equivalent: 1.34 lb./sq.ft.-year, 70,667 lb./building-year
Increased Cost / lb. CO2-e reduction: $0.95

Conclusions

Regardless of the building design, occupancy profile and number of stories, the incremental improvement in overall annual energy performance of buildings which exceed the 2008 Title 24 Building Energy Efficiency Standards by 15% appears cost-effective. However, each building's overall design, occupancy type and specific design choices may allow for a large range of incremental first cost and payback. As with simply meeting the requirements of the Title 24 energy standards, a permit applicant complying with the energy requirements of a green building ordinance should carefully analyze building energy performance to reduce incremental first cost and the payback for the required additional energy efficiency measures.