

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

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1.0 Executive Summary

The City of Chula Vista City Council approved the first reading of its energy ordinance on October 20, 2009 (“An Ordinance of the City of Chula Vista Amending Chapter 15.26 of the Chula Vista Municipal Code and Adding Section 15.26.030, Increased Energy Efficiency Standards”).

Gabel Associates has researched and reviewed the feasibility and energy cost-effectiveness of permit applicants exceeding the state’s 2008 Building Energy Efficiency Standards in order to meet the minimum energy efficiency requirements of the proposed ordinance. The cost-effectiveness study was reviewed by and formally presented to the City Council as part of its deliberation in unanimously approving the new ordinance.

Overall Scope of the Ordinance

| | |
|---|---|
| New ordinance or revision to previous ordinance? | New Ordinance |
| Projected Effective Date: | 1/1/2010 (or soon thereafter) |
| Green building or stand-alone energy ordinance? | Stand-alone Energy Ordinance |
| Do minimum energy requirements increase after initial effective date? | No |
| Occupancies covered? | Low-Rise and High-rise Residential, Nonresidential |
| Energy requirements apply to new construction, additions, alterations? | New Construction and Some Additions |
| Special or unusual energy requirements? | No |
| Third party verification? | No |
| Implementation details in the ordinance or in a separate document? | No special implementation guidelines. |

Key Features of the Ordinance By Occupancy Type

| Occupancy Type | Minimum Energy Requirement |
|---|-----------------------------------|
| New Low-rise Residential Buildings | 15% Better-than-Title 24 |
| Additions to Low-rise Residential Buildings | |
| < or = 1,000 SF | 2008 Title 24 Standards |
| > 1,000 SF | 15% Better-than-Title 24 |
| New Nonresidential, Hotel/Motel & High-rise Residential Buildings | 15% Better-than-Title 24 |
| Additions to Nonresidential, Hotel/Motel & High-rise Residential Buildings | |
| < or = 10,000 SF | 2008 Title 24 Standards |
| > 10,000 SF | 15% Better-than-Title 24 |

2.0 Impacts of the New Ordinance

Energy performance impacts of the Ordinance have been evaluated using several case studies which reflect a broad range of building types covered by the Ordinance.

- Two single family homes
- A low-rise multi-family building
- A high-rise residential building
- A nonresidential (office) building

Overall Case Study Method

The methodology used in these case studies is based on the way that real buildings are designed and evaluated in just meeting or exceeding the energy standards.

- (a) Each building design is tested for compliance with the 2008 Standards. The energy measures chosen are not all the prescriptive measures, but are a combination of measures which reflects how designers, builders and developers are likely to achieve a specified level of performance. For single family home designs, all four cardinal orientations are run to find the worst-case scenario for this step and in step (b) below.
- (b) Starting with a 2008 Standards minimally compliant set of measures, various items are changed to just reach the next increment of energy performance (e.g, 10%, 15% and 20% better than Title 24). In this study, the design choices are based on many years of experience with architects, mechanical engineers and builders as well general knowledge of the relative incremental costs of most measures.
- (c) A minimum and maximum range of incremental costs of added energy measures is established by a variety of research means. Site energy in KWh and Therms is calculated for each run to establish the annual energy savings, energy cost savings and CO₂-equivalent reductions in greenhouse gases.
- (d) Different metrics are generated to illustrate different aspects of cost-effectiveness by building type and climate zone.

The goal of these case studies is to provide relatively real-world order-of-magnitude results for local jurisdictions attempting to understand and calibrate energy and cost impacts of local energy ordinances or local green building ordinances. In this limited study, no attempt has been made to gather statistically significant data that can be applied to all new construction projects and thereby determine the macro-effects of specific policy decisions.

2.1 Single Family House Case Studies

House Designs. A typical single family home design is modeled to just meet the overall TDV energy performance requirements of 2008 Title 24 standards using a 2008 Standards research version of Micropas. Incremental improvements to building energy efficiency measures then are made to reduce TDV energy to:

- (a) 10% less than the 2008 standards;
- (b) 15% less than the 2008 standards; and,
- (c) 20% less than the 2008 standards.

The following measures were first evaluated so that the house design just meets the 2008 standards in each climate zone.

CLIMATE ZONE #7

Climate Zone #7: 2,025 SF 2-story home 2008 Title 24 Base Case, 20.2% total glazing area:

- R-38 roof w/ radiant barrier
- R-13 exterior walls
- R-0 slab-on-grade, R-19 over garage at 2nd floor
- Low E vinyl windows, U=0.40, SHGC=0.36 w/ no overhangs
- Furnace: 80% AFUE; No Cooling
- R-6.0 ducts in the attic
- DHW: 50 gallon gas water heater, EF=0.62; no extra pipe insulation

Climate Zone #7: 2,975 SF 2-story home 2008 Title 24 Base Case, 22.0% total glazing area:

- R-38 roof w/ radiant barrier
- R-15 exterior walls
- R-0 slab-on-grade, R-19 over garage at 2nd floor
- Low E vinyl windows, U=0.40, SHGC=0.36 w/ no overhangs
- Furnace: 80% AFUE; No Cooling
- R-6.0 ducts in the attic
- DHW: 50 gallon gas water heater, EF=0.62; no extra pipe insulation

CLIMATE ZONE #10

Climate Zone #10: 2,025 SF 2-story home 2008 Title 24 Base Case, **20.2% total glazing** area:

- R-38 roof w/ radiant barrier
- R-15 exterior walls
- R-0 slab-on-grade, R-19 over garage at 2nd floor
- Low E2 vinyl windows, U=0.36, SHGC=0.30 w/ no overhangs
- Furnace, 80% AFUE
- Air Conditioner, 13.0 SEER: TXV + Refrig. Charge (HERS)
- R-6 ducts in the attic
- Reduced duct leakage/testing (HERS)
- DHW: 50 gallon gas water heater, EF=0.62; w/ all pipe insulation

Climate Zone #10: 2,975 SF 2-story home 2008 Title 24 Base Case, **22.0% total glazing** area:

- R-38 roof w/ radiant barrier
- R-15 exterior walls
- R-0 slab-on-grade
- Low E2 vinyl windows, U=0.36, SHGC=0.23 w/ no overhangs
- Furnace, 80% AFUE
- Air Conditioner, 13.0 SEER / 11.0 EER (HERS): TXV + Refrig. Charge (HERS)
- R-6 ducts in the attic
- Reduced duct leakage/testing (HERS)
- DHW: 50 gallon gas water heater, EF=0.62; no extra pipe insulation

Energy Measures Needed to Exceed the 2008 Standards

The following energy features have been modified from the above Title 24 set of measures so that the proposed design uses less TDV energy than the 2008 standards. The added first cost of that measure compared with the equivalent 2008 Title 24 design measure is listed to the right, and the sum of all incremental costs is listed.

CLIMATE ZONE #7

(A-10%) 2,025 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|--|--------------------------------|
| • R-15 wall: 2,550 sf @\$0.12 to \$0.20/sf | \$ 305 - 510 |
| • <u>Reduced duct leakage (installation testing & HERS inspection)</u> | \$ 300 - 600 |
| Total incremental cost of Ordinance energy measure: | \$ 605 - 1,110 |
| Incremental cost in \$/sq.ft.: | \$ 0.30 to 0.55 /sq.ft. |
| Average Incremental Cost = \$858 or \$0.42 /sf | |

(A-15%) 2,025 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

| | |
|--|--------------------------------|
| • R-15 wall: 2,550 sf @\$0.12 to \$0.20/sf | \$ 305 - 510 |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 409 sf @ \$1.35 - \$1.50/sf | \$ 550 - 615 |
| • <u>Reduced duct leakage (installation testing & HERS inspection)</u> | <u>\$ 300 - 600</u> |
| Total incremental cost of Ordinance energy measure: | \$ 1,155 - 1,725 |
| Incremental cost in \$/sq.ft.: | \$ 0.57 to 0.85 /sq.ft. |
| Average Incremental Cost = \$1,440 or \$0.71 /sf | |

(A-20%) 2,025 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|---|--------------------------------|
| • R-15 wall: 2,550 sf @\$0.12 to \$0.20/sf | \$ 305 - 510 |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 409 sf @ \$1.35 - \$1.50/sf | \$ 550 - 615 |
| • R-4.2 ducts (from R-6.0) | \$ (325 - 225) |
| • <u>Tankless gas DHW, 0.80 EF (5 to 10 gpm)</u> | <u>\$ 900 - 1,500</u> |
| Total incremental cost of Ordinance energy measure: | \$ 1,430 - 2,400 |
| Incremental cost in \$/sq.ft.: | \$ 0.71 to 1.19 /sq.ft. |
| Average Incremental Cost = \$1,915 or \$0.95 /sf | |

(A-10%) 2,975 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|--|--------------------------------|
| • R-13 walls (from R-15): 2,204 sf @\$0.12 to \$0.20/sf | \$ (440 - 265) |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 655 sf @ \$1.35 - \$1.50/sf | \$ 885 - 980 |
| • <u>Reduced duct leakage (installation testing & HERS inspection)</u> | <u>\$ 300 - 600</u> |
| Total incremental cost of Ordinance energy measure: | \$ 745 - 1,315 |
| Incremental cost in \$/sq.ft.: | \$ 0.25 to 0.44 /sq.ft. |
| Average Incremental Cost = \$1,030 or \$0.35 /sf | |

(A-15%) 2,975 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

| | |
|---|--------------------------------|
| • R-30 roof (from R-38): 1,775 sf @\$0.10 to \$0.15/sf | \$ (270 - 180) |
| • R-13 walls (from R-15): 2,204 sf @\$0.12 to \$0.20/sf | \$ (440 - 265) |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 655 sf @ \$1.35 - \$1.50/sf | \$ 885 - 980 |
| • <u>Tankless gas DHW, 0.80 EF (5 to 10 gpm)</u> | <u>\$ 900 - 1,500</u> |
| Total incremental cost of Ordinance energy measure: | \$ 1,075 - 2,035 |
| Incremental cost in \$/sq.ft.: | \$ 0.36 to 0.68 /sq.ft. |
| Average Incremental Cost = \$1,555 or \$0.52 /sf | |

(A-20%) 2,975 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|---|--------------------------------|
| • R-8 attic ducts | \$ 275 - 375 |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 655 sf @ \$1.35 - \$1.50/sf | \$ 885 - 980 |
| • Tankless gas DHW, 0.80 EF (5 to 10 gpm) | \$ 900 - 1,500 |
| Total incremental cost of Ordinance energy measure: | \$ 2,060 - 2,855 |
| Incremental cost in \$/sq.ft.: | \$ 0.69 to 0.96 /sq.ft. |
| Average Incremental Cost = \$2,458 or \$0.83 /sf | |

CLIMATE ZONE #10

(A-10%) 2,025 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|--|--------------------------------|
| • 15 SEER/12 EER air conditioner (HERS) | \$ 500 - 1,500 |
| • R-8 attic ducts | \$ 275 - 375 |
| Total incremental cost of Ordinance energy measure: | \$ 775 - 1,875 |
| Incremental cost in \$/sq.ft.: | \$ 0.38 to 0.93 /sq.ft. |
| Average Incremental Cost = \$1,325 or \$0.65 /sf | |

(A-15%) 2,025 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

| | |
|--|--------------------------------|
| • R-30 floor over garage: 448 sf @ \$0.12 to \$0.20/sf | \$ 55 - 90 |
| • 15 SEER/12 EER air conditioner (HERS) | \$ 500 - 1,500 |
| • No extra pipe insulation | \$ (200 - 150) |
| • Tankless gas DHW, 0.80 EF (5 to 10 gpm) | \$ 900 - 1,500 |
| Total incremental cost of Ordinance energy measure: | \$ 1,255 - 2,940 |
| Incremental cost in \$/sq.ft.: | \$ 0.62 to 1.45 /sq.ft. |
| Average Incremental Cost = \$2,098 or \$1.04 /sf | |

(A-20%) 2,025 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|--|--------------------------------|
| • R-30 floor over garage: 448 sf @ \$0.12 to \$0.20/sf | \$ 55 - 90 |
| • 15 SEER/12 EER air conditioner (HERS) | \$ 500 - 1,500 |
| • No extra pipe insulation | \$ (200 - 150) |
| • Quality insulation installation (includes HERS inspection) | \$ 250 - 350 |
| • Tankless gas DHW, 0.80 EF (5 to 10 gpm) | \$ 900 - 1,500 |
| Total incremental cost of Ordinance energy measure: | \$ 1,505 - 3,290 |
| Incremental cost in \$/sq.ft.: | \$ 0.74 to 1.62 /sq.ft. |
| Average Incremental Cost = \$2,398 or \$1.18 /sf | |

(A-10%) 2,975 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|--|--------------------------------|
| • R-13 walls (from R-15): 2,204 sf @\$0.12 to \$0.20/sf | \$ (440 - 265) |
| • 15 SEER/12 EER air conditioner (HERS) | \$ 500 - 1,500 |
| • R-8 attic ducts | \$ 275 - 375 |
| • Tankless gas DHW, 0.80 EF (5 to 10 gpm) | \$ 900 - 1,500 |
| Total incremental cost of Ordinance energy measure: | \$ 1,235 - 3,110 |
| Incremental cost in \$/sq.ft.: | \$ 0.42 to 1.05 /sq.ft. |
| Average Incremental Cost = \$2,173 or \$0.73 /sf | |

(A-15%) 2,975 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

| | |
|---|--------------------------------|
| • R-13 walls (from R-15): 2,204 sf @\$0.12 to \$0.20/sf | \$ (440 - 265) |
| • Super Low-E2 windows: U-factor=0.36, SHGC=0.23 655 sf @ \$1.35 - \$1.50/sf | \$ 885 - 980 |
| • 15 SEER/12 EER air conditioner (HERS) | \$ 500 - 1,500 |
| • Tankless gas DHW, 0.80 EF (5 to 10 gpm) | \$ 900 - 1,500 |
| Total incremental cost of Ordinance energy measure: | \$ 1,845 - 3,715 |
| Incremental cost in \$/sq.ft.: | \$ 0.62 to 1.25 /sq.ft. |
| Average Incremental Cost = \$2,780 or \$0.93 /sf | |

(A-20%) 2,975 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|---|--------------------------------|
| • Super Low-E2 windows: U-factor=0.36, SHGC=0.23 655 sf @ \$1.35 - \$1.50/sf | \$ 885 - 980 |
| • Furnace, 90% AFUE (from 80%) | \$ 500 - 1,000 |
| • 15 SEER/12 EER air conditioner (HERS) | \$ 500 - 1,500 |
| • R-8 attic ducts | \$ 275 - 375 |
| • Tankless gas DHW, 0.80 EF (5 to 10 gpm) | \$ 900 - 1,500 |
| Total incremental cost of Ordinance energy measure: | \$ 3,060 - 5,355 |
| Incremental cost in \$/sq.ft.: | \$ 1.03 to 1.80 /sq.ft. |
| Average Incremental Cost = \$4,208 or \$1.41 /sf | |

2.2 Low-rise Multi-family Building Case Study

Building Design. A typical 8-unit, 2-story low-rise multi-family building is modeled to just meet the overall TDV energy performance requirements of 2008 Title 24 standards using a 2008 Standards research version of Micropas. Incremental improvements to building energy efficiency measures then are made to reduce TDV energy to:

- (a) 10% less than the 2008 standards;
- (b) 15% less than the 2008 standards;
- (c) 20% less than the 2008 standards; and,

The following measures were first evaluated so that the house design just meets the 2008 standards in each climate zone as follows:

Climate Zone #7: 8,442 SF 2-story building 2008 Title 24 Base Case, 12.5% total glazing area:

- R-30 roof, R-13 exterior walls, slab-on-grade 1st floor
- Dual vinyl windows, U=0.40, SHGC=0.36 w/ no overhangs
- Furnaces: 80% AFUE; No Cooling
- R-4.2 ducts in the attic
- DHW: 40 gallon gas water heater, EF=0.60; no extra pipe insulation

Climate Zone #10: 8,442 SF 2-story building 2008 Title 24 Base Case, 12.5% total glazing area:

- R-38 roof w/ radiant barrier, R-15 exterior walls, slab-on-grade 1st floor
- House wrap
- Dual vinyl windows, U=0.36, SHGC=0.30 w/ no overhangs
- Furnaces: 80% AFUE
- Air conditioner: 13.0 SEER, 10.0 EER
- Reduced duct leakage (HERS measure)
- R-8 ducts in the attic
- DHW: 40 gallon gas water heater, EF=0.63; extra pipe insulation

Energy Measures Needed to Exceed the 2008 Standards

The following energy features have been modified from the above Title 24 set of measures so that the proposed design uses less TDV energy than the 2008 standards. The added first cost of that measure compared with the equivalent 2008 Title 24 design measure is listed to the right, and the sum of all incremental costs is listed.

CLIMATE ZONE #7

(A-10%) 8,442 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|---|--------------------------------|
| • R-38 roof, 2,880 sf @\$0.10 - \$0.20 /sf | \$ 290 - 575 |
| • R-6 ducts (from R-4.2) | \$ 1,000 - 1,400 |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 1,055 sf @ \$1.00 - \$1.50/sf | \$ 1,055 - 1,585 |
| • (8) 0.63 EF water heaters (from 0.60 EF) | \$ 800 - 1,600 |
| • House wrap: 9,266 sf @ \$0.08 to \$0.12/sf | \$ 745 - 1,115 |
| Total incremental cost of Ordinance energy measure: | \$ 3,890 - 6,275 |
| Incremental cost in \$/sq.ft.: | \$ 0.46 to 0.74 /sq.ft. |

Average Incremental Cost = \$5,083 or \$0.60 /sf

(A-15%) 8,442 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

| | |
|---|--------------------------------|
| • R-38 roof, 2,880 sf @\$0.10 - \$0.20 /sf | \$ 290 - 575 |
| • R-6 ducts (from R-4.2) | \$ 1,000 - 1,400 |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 1,055 sf @ \$1.00 - \$1.50/sf | \$ 1,055 - 1,585 |
| • (8) 0.63 EF water heaters (from 0.60 EF) | \$ 800 - 1,600 |
| • Reduced duct leakage (installation testing & HERS inspection) | \$ 2000 - 4000 |
| • R-15 wall insulation: 9,266_sf @ \$0.06 to \$0.08 sf_ | \$ 560 - 745 |
| • Pipe insulation @\$150 - \$300/unit | \$ 1,200 - 2,400 |
| Total incremental cost of Ordinance energy measure: | \$ 6,905-12,305 |
| Incremental cost in \$/sq.ft.: | \$ 0.82 to 1.46 /sq.ft. |

Average Incremental Cost = \$9,605 or \$1.14 /sf

(A-20%) 8,442 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|---|--------------------------------|
| • R-19 roof, 2,880 sf @\$0.19 - \$0.22 /sf | (\$ 635 - 545) |
| • (8) 0.80 EF tankless water heaters (from 0.60 EF) | \$ 7,200 -12,000 |
| • Low-E2 windows: U-factor=0.36, SHGC=0.30 1,055 sf @ \$1.00 - \$1.50/sf | \$ 1,055 - 1,585 |
| • No roof radiant barrier 2,880sf @-\$0.12 to -\$0.18/sf | (\$ 520 - 345) |
| Total incremental cost of Ordinance energy measure: | \$ 7,045 - 12,785 |
| Incremental cost in \$/sq.ft.: | \$ 0.83 to 1.51 /sq.ft. |

Average Incremental Cost = \$9,915 or \$1.17 /sf

CLIMATE ZONE #10

(A-10%) 8,442 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

- R-6 ducts (from R-8) (\$ 1,600 - 1,000)
 - Reduced duct leakage (installation testing & HERS inspection) \$ 2000 - 4000
 - TXV/Refrig. Charge (HERS inspection) \$ 300 - 500
 - (8) 15 SEER/12 EER air conditioners \$ 2,800 -10,800
 - Total incremental cost of Ordinance energy measure: \$ 3,500 -14,300**
 - Incremental cost in \$/sq.ft.: \$ 0.41 to 1.69 /sq.ft.**
- Average Incremental Cost = \$8,900 or \$1.05 /sf**

(A-15%) 8,442 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

- Reduced duct leakage (installation testing & HERS inspection) \$ 2000 - 4000
 - TXV/Refrig. Charge (HERS inspection) \$ 300 - 500
 - Low-E3 windows: U-factor=0.36, SHGC=0.23
1,055 sf @ \$1.35 - \$1.50/sf \$ 1,425 - 1,585
 - (8) 15 SEER/12 EER air conditioners \$ 2,800 -10,800
 - Total incremental cost of Ordinance energy measure: \$ 6,525 -16,885**
 - Incremental cost in \$/sq.ft.: \$ 0.77 to 2.00 /sq.ft.**
- Average Incremental Cost = \$11,705 or \$1.39 /sf**

(A-20%) 8,442 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

- (8) 15 SEER/12 EER air conditioners \$ 2,800 -10,800
 - TXV/Refrig. Charge (HERS inspection) \$ 300 - 500
 - Reduced duct leakage (installation testing & HERS inspection) \$ 2,000 - 4,000
 - R-6 ducts (from R-8) (\$ 1,600 - 1,000)
 - No pipe insulation @\$150 - \$300/unit (\$ 2,400 - 1,200)
 - No house wrap: 9,266 sf @ \$0.08 to \$0.12/sf (\$ 1,115 - 745)
 - (8) 0.80 EF tankless water heaters (from 0.63 EF) \$ 6,400 -10,400
 - Total incremental cost of Ordinance energy measure: \$ 6,385 - 22,755**
 - Incremental cost in \$/sq.ft.: \$ 0.76 to 2.70 /sq.ft.**
- Average Incremental Cost = \$14,570 or \$1.73 /sf**

2.3 High-Residential Building Case Study

High Residential Building Design. A typical high-rise residential building has been modeled with a research version of EnergyPro has been used to evaluate compliance with the 2008 Nonresidential, Hotel/Motel and High-rise Residential standards. The following measures were evaluated so the building just meets the 2008 standards.

Building Description: 36,800 SF, 4 stories of apartments above a 1st floor retail level building, 35.2% Window Wall Ratio glazing area, w/ 40 dwelling units, including the following energy measures:

Climate Zone #7 Base Case Measures Which Just Meet 2008 Title 24

- R-19 attic insulation, R-19 walls in metal stud exterior walls
- Un-insulated (R-0) raised slab floor over parking garage;
- Dual metal NFRC-rated Low-E windows: U-factor=0.48, SHGC=0.43
- (2) room heat pumps for each dwelling unit: HSPF=7.2, EER=10.2
- Central domestic hot water boiler, 80% AFUE; re-circulating system w/ timer and temperature controls; variable speed drive hot water pump

Climate Zone #10 Base Case Measures Which Just Meet 2008 Title 24

- R-19 attic insulation, R-19 walls in metal stud exterior walls
- Un-insulated (R-0) raised slab floor over parking garage;
- Dual vinyl NFRC-rated Low-E windows: U-factor=0.33, SHGC=0.30
- (2) room heat pumps for each dwelling unit: HSPF=7.2, EER=10.2
- Central domestic hot water boiler, 82.7% AFUE; re-circulating system w/ timer and temperature controls; variable speed drive hot water pump

Energy Measures Needed to Exceed the 2008 Standards

Under two different scenarios, (A) and (B), the following energy features have been modified from the above Title 24 set of measures so that the proposed design uses 10%, 15% and 20% less TDV energy than the 2008 standards. The added first cost of that measure compared with the equivalent 2008 Title 24 design measure is listed to the right, and the sum of all incremental costs is listed.

CLIMATE ZONE #7

(A-10%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

- | | |
|---|--------------------------------|
| • Low-E glazing: U=0.48, SHGC=0.35, 6,240 sf @ \$1.50 - \$1.80/sf | \$ 9,360 - 11,232 |
| • R-38 cool roof, reflectance=0.70, emittance=0.75 9,200 sf @ \$0.55 - \$0.75/sf | \$ 5,060 - 6,900 |
| Total incremental cost of Ordinance energy measure: | \$14,420 - 18,132 |
| Incremental cost in \$/sq.ft.: | \$ 0.39 to 0.49 /sq.ft. |

Average Incremental Cost = \$16,276 or \$0.44 /sf

(B-10%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

- Higher efficiency heat pumps: HSPF=7.84 EER=11.2
80 units total @\$180 - \$300 each \$14,400 - 24,000
 - 82.7% AFUE hot water boiler \$ 1,000 - 1,800
 - R-38 cool roof, reflectance=0.70, emittance=0.75
9,200 sf @ \$0.55 - \$0.75/sf \$ 5,060 - 6,900
- Total incremental cost of Ordinance energy measure: \$20,460 - 32,700**
Incremental cost in \$/sq.ft.: \$ 0.56 to 0.89 /sq.ft.
Average Incremental Cost = \$26,580 or \$0.72 /sf

Climate Zone #7, Exceeding the 2008 Standards by 10%

Average Incremental Cost for Two Compliance Scenarios: \$0.58 /sf

(A-15%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

- Low-E glazing: U=0.48, SHGC=0.35,
6,240 sf @ \$1.50 - \$1.80/sf \$ 9,360 - 11,232
 - R-38 cool roof, reflectance=0.70, emittance=0.75
9,200 sf @ \$0.55 - \$0.75/sf \$ 5,060 - 6,900
 - (2) Munchkin boilers 92% AFUE @\$1,500 - \$2,500 each \$ 3,000 - 5,000
 - Premium efficiency pump motors \$ 300 - 500
- Total incremental cost of Ordinance energy measure: \$17,720 - 23,632**
Incremental cost in \$/sq.ft.: \$ 0.48 to 0.64 /sq.ft.
Average Incremental Cost = \$20,676 or \$0.56 /sf

(B-15%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

- Low-E glazing: U=0.48, SHGC=0.35,
6,240 sf @ \$1.50 - \$1.80/sf \$ 9,360 - 11,232
 - Higher efficiency heat pumps: HSPF=7.84 EER=11.2
80 units total @\$180 - \$300 each \$14,400 - 24,000
 - (2) Munchkin boilers 92% AFUE @\$1,500 - \$2,500 each \$ 3,000 - 5,000
 - R-30 roof, 9,200 sf @ \$0.20 - \$0.30/sf \$ 1,840 - 2,760
- Total incremental cost of Ordinance energy measure: \$28,600 - 42,992**
Incremental cost in \$/sq.ft.: \$ 0.78 to 1.17 /sq.ft.
Average Incremental Cost = \$35,796 or \$0.97 /sf

Climate Zone #7, Exceeding the 2008 Standards by 15%

Average Incremental Cost for Two Compliance Scenarios: \$0.77 /sf

(A-20%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|---|--------------------------------|
| • Low-E glazing: U=0.51, SHGC=0.23, 6,240 sf @ \$3.50 - \$5.00/sf | \$21,840 - 31,200 |
| • R-38 cool roof, reflectance=0.70, emittance=0.75 9,200 sf @ \$0.55 - \$0.75/sf | \$ 5,060 - 6,900 |
| • R-4, 1+” spray-on insulation below raised slab; 9,200 sf @\$1.50 - \$2.50/sf | \$13,800 - 23,000 |
| • 82.7% AFUE hot water boiler | \$ 1,000 - 1,800 |
| Total incremental cost of Ordinance energy measure: | \$41,700 - 62,900 |
| Incremental cost in \$/sq.ft.: | \$ 1.13 to 1.71 /sq.ft. |

Average Incremental Cost = \$52,300 or \$1.42 /sf

(B-20%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|--|--------------------------------|
| • Low-E glazing: U=0.48, SHGC=0.35, 6,240 sf @ \$1.50 - \$1.80/sf | \$ 9,360 - 11,232 |
| • Higher efficiency heat pumps: HSPF=7.84 EER=11.2 80 units total @\$180 - \$300 each | \$14,400 - 24,000 |
| • (2) Munchkin boilers 92% AFUE @\$1,500 - \$2,500 each | \$ 3,000 - 5,000 |
| • R-4, 1+” spray-on insulation below raised slab; 9,200 sf @\$1.50 - \$2.50/sf | \$13,800 - 23,000 |
| • R-38 + R-6.5 Cool Roof, 9,200 sf @ \$1.55 - \$2.00/sf | \$14,260 - 18,400 |
| Total incremental cost of Ordinance energy measure: | \$54,820 - 81,632 |
| Incremental cost in \$/sq.ft.: | \$ 1.49 to 2.22 /sq.ft. |

Average Incremental Cost = \$68,226 or \$1.85 /sf

Climate Zone #7, Exceeding the 2008 Standards by 20%

Average Incremental Cost for Two Compliance Scenarios: \$1.64 /sf

CLIMATE ZONE #10

(A-10%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|---|--------------------------------|
| • Super Low-E glazing: U=0.48, SHGC=0.22, 6,240 sf @ \$1.35 - \$1.50/sf | \$ 8,425 - 9,360 |
| • R-38 cool roof, reflectance=0.70, emittance=0.75 9,200 sf @ \$0.55 - \$0.75/sf | \$ 5,060 - 6,900 |
| Total incremental cost of Ordinance energy measure: | \$13,485 - 16,260 |
| Incremental cost in \$/sq.ft.: | \$ 0.37 to 0.44 /sq.ft. |

Average Incremental Cost = \$14,873 or \$0.40 /sf

(B-10%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

- R-3.2 (1") K-13 spray-on insulation under raised floor
9,200 sf @ \$1.20 - \$1.50/sf \$11,040 - 13,800
 - Higher efficiency heat pumps: HSPF=7.84 EER=11.2
80 units total @\$180 - \$300 each \$14,400 - 24,000
 - R-38 roof, 9,200 sf @ \$0.30 - \$0.40/sf \$ 5,060 - 6,900
- Total incremental cost of Ordinance energy measure: \$30,500 - 44,700**
Incremental cost in \$/sq.ft.: \$ 0.83 to 1.21 /sq.ft.
- Average Incremental Cost = \$37,600 or \$1.02 /sf**

Climate Zone #10, Exceeding the 2008 Standards by 10%

Average Incremental Cost for Two Compliance Scenarios: \$0.71 /sf

(A-15%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

- Super Low-E glazing: U=0.48, SHGC=0.22,
6,240 sf @ \$1.35 - \$1.50/sf \$ 8,425 - 9,360
 - (2) Munchkin boilers 92% AFUE @\$1,500 - \$2,500 each \$ 3,000 - 5,000
 - R-6, 2" spray-on insulation below raised slab; 9,200 sf
@\$2.25 - \$3.25/sf \$ 20,700 - 29,900
 - R-38 cool roof, reflectance=0.70, emittance=0.75
9,200 sf @ \$0.55 - \$0.75/sf \$ 5,060 - 6,900
- Total incremental cost of Ordinance energy measure: \$ 37,185 - 51,160**
Incremental cost in \$/sq.ft.: \$ 1.01 to 1.39 /sq.ft.
- Average Incremental Cost = \$44,173 or \$1.20 /sf**

(B-15%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

- R-6, 2" spray-on insulation below raised slab; 9,200 sf
@\$2.25 - \$3.25/sf \$ 20,700 - 29,900
 - (2) Munchkin boilers 92% AFUE @\$1,500 - \$2,500 each \$ 3,000 - 5,000
 - Higher efficiency heat pumps: HSPF=7.84 EER=11.2
80 units total @\$180 - \$300 each \$ 14,400 - 24,000
 - R-38 roof, 9,200 sf @ \$0.30 - \$0.40/sf \$ 5,060 - 6,900
 - 18% Net Solar Fraction solar hot water \$ 40,000 - 56,000
- Total incremental cost of Ordinance energy measure: \$ 83,160 - 113,800**
Incremental cost in \$/sq.ft.: \$ 2.26 to 3.09 /sq.ft.
- Average Incremental Cost = \$98,480 or \$2.68 /sf**

Climate Zone #10, Exceeding the 2008 Standards by 15%

Average Incremental Cost for Two Compliance Scenarios: \$1.94 /sf

(A-20%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|--|--------------------------------|
| • Super Low-E glazing: U=0.48, SHGC=0.22, 6,240 sf @ \$1.35 - \$1.50/sf | \$ 8,425 - 9,360 |
| • R-6, 2" spray-on insulation below raised slab; 9,200 sf @\$2.25 - \$3.25/sf | \$ 20,700 - 29,900 |
| • (2) Munchkin boilers 92% AFUE @\$1,500 - \$2,500 each | \$ 3,000 - 5,000 |
| • Higher efficiency heat pumps: HSPF=7.84 EER=11.2 80 units total @\$180 - \$300 each | \$ 14,400 - 24,000 |
| • R-38 cool roof, reflectance=0.70, emittance=0.75 9,200 sf @ \$0.55 - \$0.75/sf | \$ 5,060 - 6,900 |
| Total incremental cost of Ordinance energy measure: | \$ 51,585 - 75,160 |
| Incremental cost in \$/sq.ft.: | \$ 1.40 to 2.04 /sq.ft. |

Average Incremental Cost = \$63,373 or \$1.72 /sf

(B-20%) 36,800 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%)

| | |
|--|--------------------------------|
| • R-6, 2" spray-on insulation below raised slab; 9,200 sf @\$2.25 - \$3.25/sf | \$ 20,700 - 29,900 |
| • (2) Munchkin boilers 92% AFUE @\$1,500 - \$2,500 each | \$ 3,000 - 5,000 |
| • Higher efficiency heat pumps: HSPF=7.84 EER=11.2 80 units total @\$180 - \$300 each | \$ 14,400 - 24,000 |
| • R-38 roof, 9,200 sf @ \$0.30 - \$0.40/sf | \$ 5,060 - 6,900 |
| • 45% Net Solar Fraction solar hot water | \$100,000 - 120,000 |
| Total incremental cost of Ordinance energy measure: | \$143,160 - 185,800 |
| Incremental cost in \$/sq.ft.: | \$ 3.89 to 5.05 /sq.ft. |

Average Incremental Cost = \$164,480 or \$4.47 /sf

Climate Zone #10, Exceeding the 2008 Standards by 20%

Average Incremental Cost for Two Compliance Scenarios: \$3.10 /sf

2.4 Nonresidential Building Case Study

Nonresidential Building Design. A typical office building has been modeled with a research version of EnergyPro has been used to evaluate compliance with the 2008 Nonresidential, Hotel/Motel and High-rise Residential standards. The following measures were evaluated so the building just meets the 2008 standards.

Building Description: 52,900 SF, 5 stories, 32.5% Window Wall Ratio glazing areaincluding the following energy measures:

Climate Zone #7 Base Case Measures Which Just Meet 2008 Title 24

- R-30 cool roof reflectance=0.70, emittance=0.75
- R-19 in metal frame exterior walls, slab-on-grade 1st floor;
- NFRC-rated Low-E windows: U-factor=0.50, SHGC=0.38 (e.g., Viracon VE 1-2M) w/ no exterior shading
- Lighting = 0.885 w/sf: 650 2-lamp 4' T8 fixtures @ 62w each and 250 26w CFLs @ 26 w each; no lighting controls
- 4 identical Packaged VAV units: Aaron 25 ton, EER=10.4, 10,000 CFM, standard efficiency fan motors, 30% VAV boxes w/ reheat
- Ducts in conditioned space, R-4.2 duct insulation
- Service hot water: standard gas tank water heater

Climate Zone #10 Base Case Measures Which Just Meet 2008 Title 24

- R-30 roof, R-19 in metal frame exterior walls, slab-on-grade 1st floor;
- NFRC-rated Low-E windows: U-factor=0.50, SHGC=0.38 (e.g., Viracon VE 1-2M) w/ substantial overhang on the 1st floor only
- Lighting = 0.885 w/sf: 650 2-lamp 4' T8 fixtures with high efficiency instant start ballasts and premium T8 lamps, 50 input watts; and 250 26w CFLs @ 26w each; no lighting controls
- 4 identical Packaged VAV units: Aaron 25 ton, EER=10.4, 10,000 CFM, standard efficiency fan motors, 30% VAV boxes w/ reheat
- Ducts in conditioned space, R-4.2 duct insulation
- Service hot water: standard gas tank water heater

Energy Measures Needed to Exceed the 2008 Standards

Under two different scenarios, (A) and (B), the following energy features have been modified from the above Title 24 set of measures so that the proposed design uses 10%, 15% and 20% less TDV energy than the 2008 standards. The added first cost of that measure compared with the equivalent 2008 Title 24 design measure is listed to the right, and the sum of all incremental costs is listed.

CLIMATE ZONE #7

(A-10%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

- 650 2-lamp 4' T8 fixtures with high efficiency instant start ballasts and premium T8 lamps, 50 input watts @ \$25.00 - \$30.00/fixture; Installed LPD=0.703 w/ OS listed below \$16,250 - 19,500
 - 90 occupant sensors controlling (2) 2-lamp T8 fixtures; @\$65.00 - \$85.00 each \$ 5,850 - 7,650
 - R-38 cool roof, reflectance=0.70, emittance=0.75
9,200 sf @ \$0.55 - \$0.75/sf \$ 5,060 - 6,900
- Total incremental cost of Ordinance energy measure: \$27,160 - 34,050**
Incremental cost in \$/sq.ft.: \$ 0.51 to 0.64 /sq.ft.
Average Incremental Cost = \$30,605 or \$0.58 /sf

(B-10%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

- 650 2-lamp 4' T8 fixtures with high efficiency instant start ballasts and premium T8 lamps, 50 input watts @ \$25.00 - \$30.00/fixture; Installed LPD=0.737 \$16,250 - 19,500
 - U=0.50, SHGCc=0.31 (e.g., Viracon VE 2-2M) 7,840 sf @ \$2.00 - 3.00/sq.ft. (excludes 1st floor glazing) \$15,680 - 23,520
 - R-30 roof (no cool roof) 9,200 sf @ \$0.25 - \$0.35/sf (\$ 2,300 - 3,220)
- Total incremental cost of Ordinance energy measure: \$29,630 - 39,800**
Incremental cost in \$/sq.ft.: \$ 0.56 to 0.75 /sq.ft.
Average Incremental Cost = \$34,715 or \$0.66 /sf

Climate Zone #7, Exceeding the 2008 Standards by 10%

Average Incremental Cost for Two Compliance Scenarios: \$0.62 /sf

(A-15%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

- 650 2-lamp 4' T8 fixtures with high efficiency instant start ballasts and premium T8 lamps, 50 input watts @ \$25.00 - \$30.00/fixture; Installed LPD=0.682 w/OS \$ 16,250 - 19,500
 - 90 occupant sensors controlling (2) 2-lamp T8 fixtures; @\$65.00 - \$85.00 each \$ 5,850 - 7,650
 - 50 more recessed CFL fixtures, all CFL fixtures w/ 18w lamps @\$175 - \$250 each \$ 8,750 - 12,500
 - (5) Trane 25 ton units, EER=11.0 @ \$9,000 to \$13,000 each w/ premium fan motors \$ 45,000 - 65,000
 - R-38 cool roof, reflectance=0.70, emittance=0.75
9,200 sf @ \$0.55 - \$0.75/sf \$ 5,060 - 6,900
- Total incremental cost of Ordinance energy measure: \$ 80,910 - 111,550**
Incremental cost in \$/sq.ft.: \$ 1.53 to 2.11 /sq.ft.
Average Incremental Cost = \$96,230 or \$1.82 /sf

(B-15%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

- 650 2-lamp 4' T8 fixtures with high efficiency instant start ballasts and premium T8 lamps, 50 input watts @ \$25.00 - \$30.00/fixture; Installed LPD=0.737 \$ 16,250 - 19,500
 - U=0.50, SHGCc=0.31 (e.g., Viracon VE 2-2M) \$ 15,680 - 23,520
7,840 sf @ \$2.00 - 3.00/sq.ft. (excludes 1st floor glazing)
 - (5) Trane 25 ton units, EER=11.0 @ \$9,000 to \$13,000 each w/ premium fan motors \$ 45,000 - 65,000
 - R-30 roof (no cool roof) 9,200 sf @ \$0.25 - \$0.35/sf (\$ 2,300 - 3,220)
- Total incremental cost of Ordinance energy measure: \$ 74,630 - 104,800**
Incremental cost in \$/sq.ft.: \$ 1.41 to 1.98 /sq.ft.

Average Incremental Cost = \$89,715 or \$1.70 /sf

Climate Zone #7, Exceeding the 2008 Standards by 15%

Average Incremental Cost for Two Compliance Scenarios: \$1.76 /sf

(A-20%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%) **

- 650 2-lamp 4' T8 fixtures with high efficiency instant start ballasts and premium T8 lamps, 50 input watts @ \$25.00 - \$30.00/fixture; Installed LPD=0.682 w/OS\$ 16,250 - 19,500
 - 90 occupant sensors controlling (2) 2-lamp T8 fixtures; \$ 5,850 - 7,650
@ \$65.00 - \$85.00 each
 - 50 more recessed CFL fixtures, all CFL fixtures w/ 18w lamps @ \$175 - \$250 each \$ 8,750 - 12,500
 - U=0.50, SHGCc=0.31 (e.g., Viracon VE 2-2M) \$ 15,680 - 23,520
7,840 sf @ \$2.00 - 3.00/sq.ft. (excludes 1st floor glazing)
 - (5) Trane 25 ton units, EER=11.0 @ \$9,000 to \$13,000 each w/ premium fan motors \$ 45,000 - 65,000
 - R-38 + R-6.5 Cool Roof, 9,200 sf @ \$1.55 - \$2.00/sf \$ 14,260 - 18,400
- Total incremental cost of Ordinance energy measure: \$105,790 - 146,570**
Incremental cost in \$/sq.ft.: \$ 2.00 to 2.77 /sq.ft.

Average Incremental Cost = \$126,180 or \$2.39/sf

** Only one practical combination of energy measures was able to achieve 20% better-than-Title 24 using a mixture of "A" and "B" features.

CLIMATE ZONE #10

(A-10%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|---|--------------------------------|
| • U=0.50, SHGCc=0.31 (e.g., Viracon VE 2-2M) 7,840 sf @\$2.00 - 3.00/sq.ft. (excludes 1 st floor glazing) | \$15,680 - 23,520 |
| • 50 more recessed CFL fixtures, all CFL fixtures w/ 18w lamps @\$175 - \$250 each | \$ 8,750 - 12,500 |
| • 90 occupant sensors controlling (2) 2-lamp T8 fixtures; @\$65.00 - \$85.00 each | \$ 5,850 - 7,650 |
| • 1" R-6.5 rigid insulation + R-19 metal frame walls 20,730 sf @ \$1.75 – 2.25/sq.ft. | \$36,280 - 46,645 |
| • R-38 roof, 9,200 sf @ \$0.10 - \$0.20/sf | \$ 5,060 - 6,900 |
| Total incremental cost of Ordinance energy measure: | \$71,620 - 97,215 |
| Incremental cost in \$/sq.ft.: | \$ 1.35 to 1.84 /sq.ft. |

Average Incremental Cost = \$84,418 or \$1.60 /sf

(B-10%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 10%)

| | |
|---|--------------------------------|
| • U=0.50, SHGCc=0.31 (e.g., Viracon VE 2-2M) 7,840 sf @\$2.00 - 3.00/sq.ft. (excludes 1 st floor glazing) | \$15,680 - 23,520 |
| • 90 occupant sensors controlling (2) 2-lamp T8 fixtures; @\$65.00 - \$85.00 each | \$ 5,850 - 7,650 |
| • (5) Trane 30 ton units, EER=11.0 @ \$9,000 to \$13,000 each w/ premium fan motors | \$45,000 - 65,000 |
| Total incremental cost of Ordinance energy measure: | \$66,530 - 96,170 |
| Incremental cost in \$/sq.ft.: | \$ 1.26 to 1.82 /sq.ft. |

Average Incremental Cost = \$81,350 or \$1.54 /sf

Climate Zone #10, Exceeding the 2008 Standards by 10%

Average Incremental Cost for Two Compliance Scenarios: \$1.57 /sf

(A-15%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

| | |
|---|--------------------------------|
| • U=0.50, SHGCc=0.31 (e.g., Viracon VE 2-2M) 7,840 sf @\$2.00 - 3.00/sq.ft. (excludes 1 st floor glazing) | \$ 15,680 - 23,520 |
| • 50 more recessed CFL fixtures, all CFL fixtures w/ 18w lamps @\$175 - \$250 each | \$ 8,750 - 12,500 |
| • 100 occupant sensors controlling (2) 2-lamp T8 fixtures; @\$65.00 - \$85.00 each | \$ 6,500 - 8,500 |
| • 1" R-6.5 rigid insulation + R-19 metal frame walls 20,730 sf @ \$1.75 – 2.25/sq.ft. | \$ 36,280 - 46,645 |
| • (5) Trane 30 ton units, EER=11.0 @ \$9,000 to \$13,000 each w/ premium fan motors | \$ 45,000 - 65,000 |
| Total incremental cost of Ordinance energy measure: | \$112,210 - 156,165 |
| Incremental cost in \$/sq.ft.: | \$ 2.12 to 2.95 /sq.ft. |

Average Incremental Cost = \$134,188 or \$2.52 /sf

(B-15%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 15%)

| | |
|---|--------------------------------|
| • U=0.50, SHGCc=0.22 (e.g., Viracon VE 2-55) 7,840 sf @\$3.50 - 4.50/sq.ft. (excludes 1 st floor glazing) | \$ 27,740 - 35,280 |
| • 50 more recessed CFL fixtures, all CFL fixtures w/ 18w lamps @\$175 - \$250 each | \$ 8,750 - 12,500 |
| • 100 occupant sensors controlling (2) 2-lamp T8 fixtures; @\$65.00 - \$85.00 each | \$ 6,500 - 8,500 |
| • Total incremental cost of Ordinance energy measure: | \$ 42,990 - 56,280 |
| Incremental cost in \$/sq.ft.: | \$ 0.81 to 1.06 /sq.ft. |

Average Incremental Cost = \$49,635 or \$0.94 /sf

Climate Zone #10, Exceeding the 2008 Standards by 15%

Average Incremental Cost for Two Compliance Scenarios: \$1.74 /sf

(A-20%) 52,900 sq.ft. (Reduction in 2008 T24 TDV Energy by 20%) **

- U=0.50, SHGCc=0.22 (e.g., Viracon VE 2-55)
7,840 sf @\$3.50 - 4.50/sq.ft. (excludes 1st floor glazing) \$ 27,740 - 35,280
- 50 more recessed CFL fixtures, all CFL fixtures w/ 18w lamps
@\$175 - \$250 each \$ 8,750 - 12,500
- 100 occupant sensors controlling (2) 2-lamp T8 fixtures;
@\$65.00 - \$85.00 each \$ 6,500 - 8,500
- 1" R-6.5 rigid insulation + R-19 metal frame walls
20,730 sf @ \$1.75 – 2.25/sq.ft. \$ 36,280 - 46,645
- (5) Trane 30 ton units, EER=11.0 @ \$9,000 to \$13,000 each
w/ premium fan motors \$ 45,000 - 65,000

Total incremental cost of Ordinance energy measure: \$124,270 - 167,925

Incremental cost in \$/sq.ft.:

\$ 2.35 to 3.17 /sq.ft.

Average Incremental Cost = \$146,098 or \$2.76 /sf

*** Only one practical combination of energy measures was able to achieve 20% better-than-Title 24 using a mixture of "A" and "B" features.*

3.0 Cost Effectiveness

The tables in this section are based upon the following:

- Incremental site electricity (kWh) and natural gas (therms) saved per year as calculated using the state-approved energy compliance software;
- Average utility rates for residential buildings: \$0.187/kWh for electricity and \$1.14/therm for natural gas (in constant dollars); for nonresidential buildings: \$0.194/kWh for electricity and \$0.944/therm for natural gas (in constant dollars)
- The assumption that there is no change (i.e., no inflation or deflation) in utility rates in constant dollars over time
- The assumption that there is no increase in summer temperatures even though most scientific studies predict that global climate change will increase temperatures in the Western U.S. which will increase air conditioning energy use
- Simple Payback includes neither the cost of financing nor any external cost associated with global climate change

A set of energy measures is generally considered cost-effectiveness if the payback is less than the average useful life of those measures. In residential construction, for example, most energy measures will typically last at least 15 years, and most will not function beyond 30 years. So energy measures with a payback of around 15 years or less would usually be cost-effective, and a payback beyond 30 years usually would not. Paybacks between 15 and 30 years may be cost-effective depending on the weighted average useful life of the measures selected.

Also note that paybacks depend on the specific selection of energy measures, how they perform in a specific building design in a particular climate zone, and what the first costs are for those measures. The data summarized here is intended to be only illustrative, not comprehensive or definitive, in demonstrating the scale of typical results and the variability of results depending on the selection of energy measures and assumed first costs.

3.1 CLIMATE ZONE #7 RESULTS

Figure 3-CZ7a-1: Added First Cost – 2,025 sf 2-Story Single Family Home

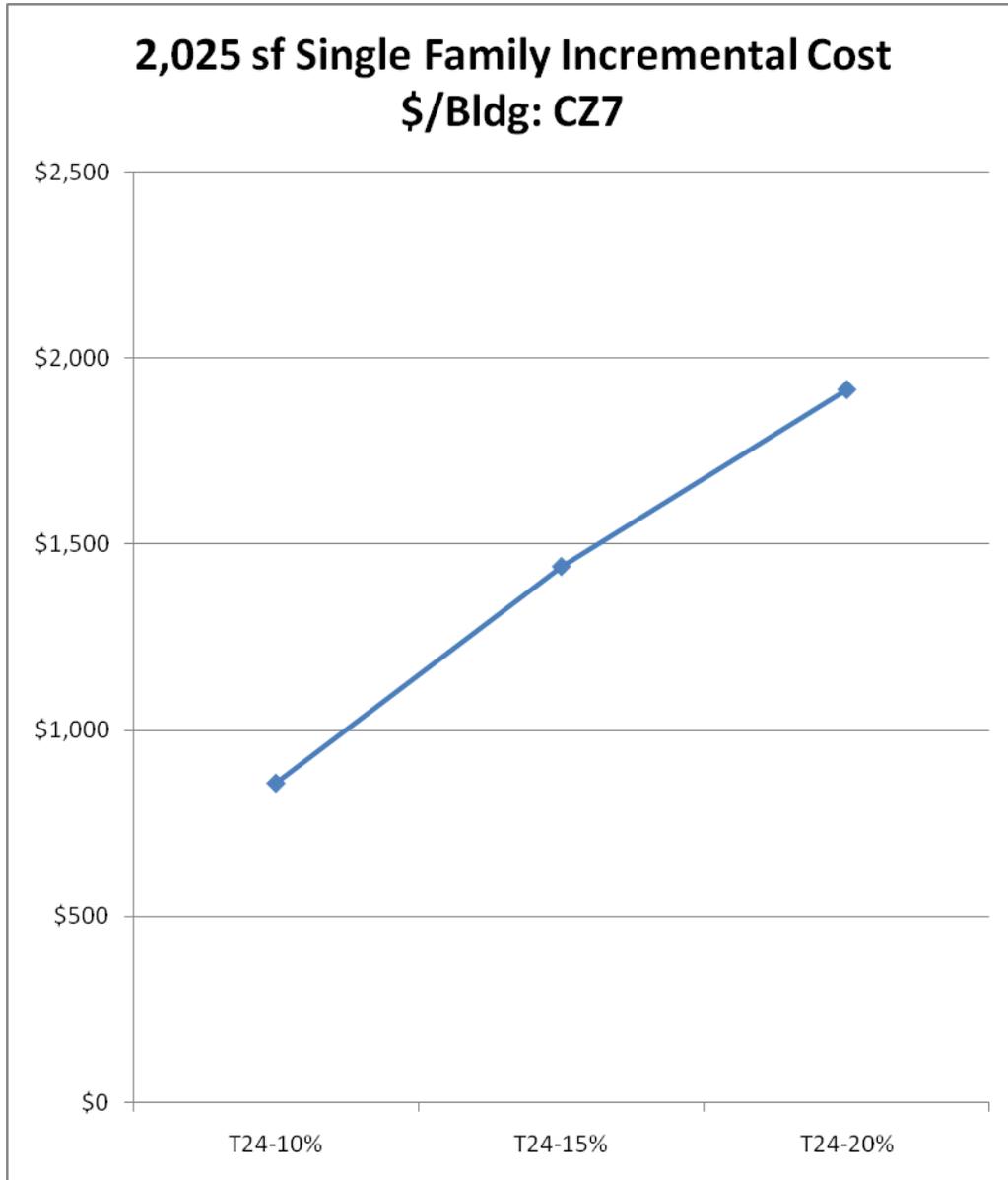


Figure 3-CZ7a-2: Added First Cost – 2,975 sf 2-Story Single Family Home

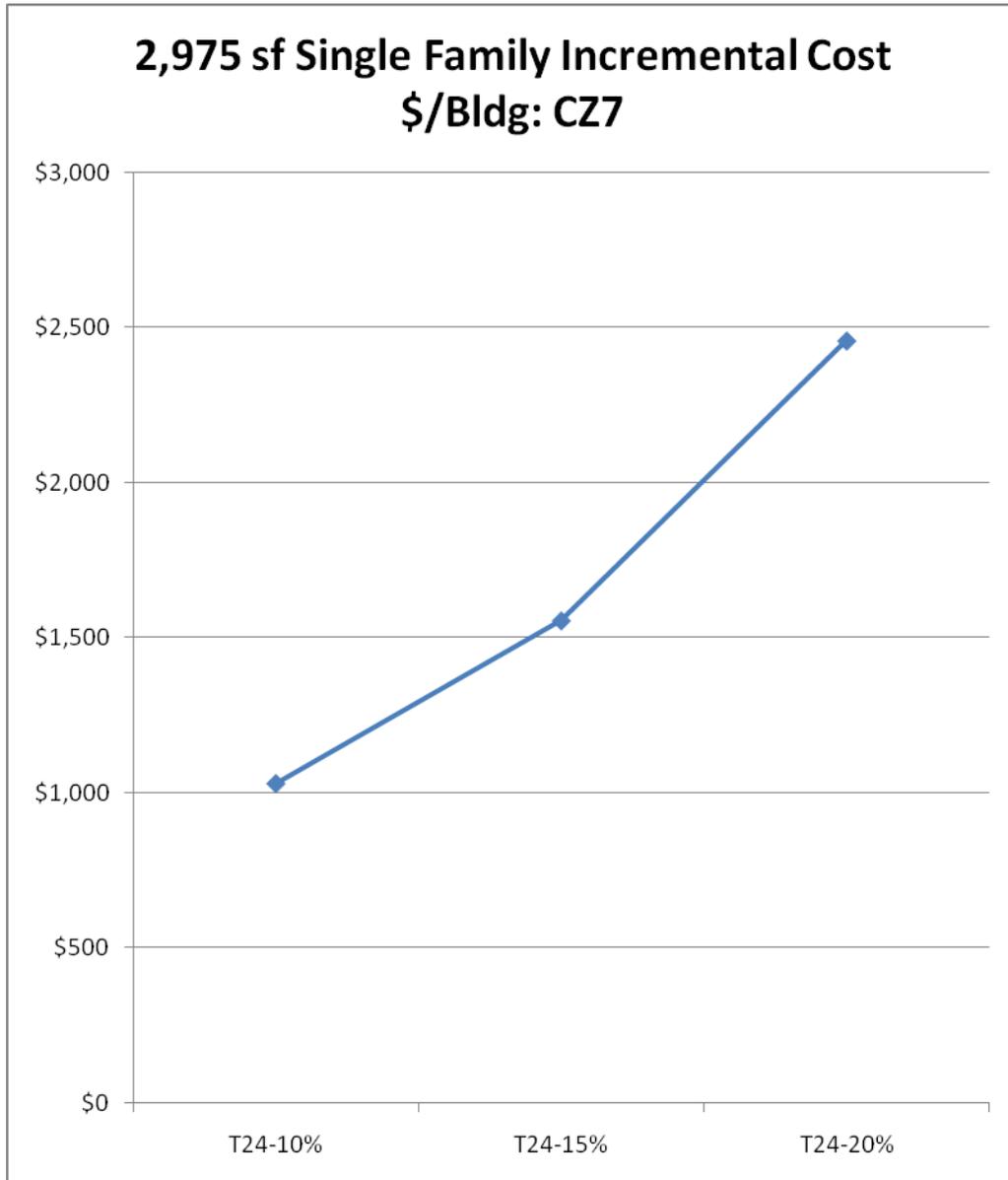


Figure 3-CZ7a-3: Added First Cost/Dwelling Unit, 2-Story Multifamily Building

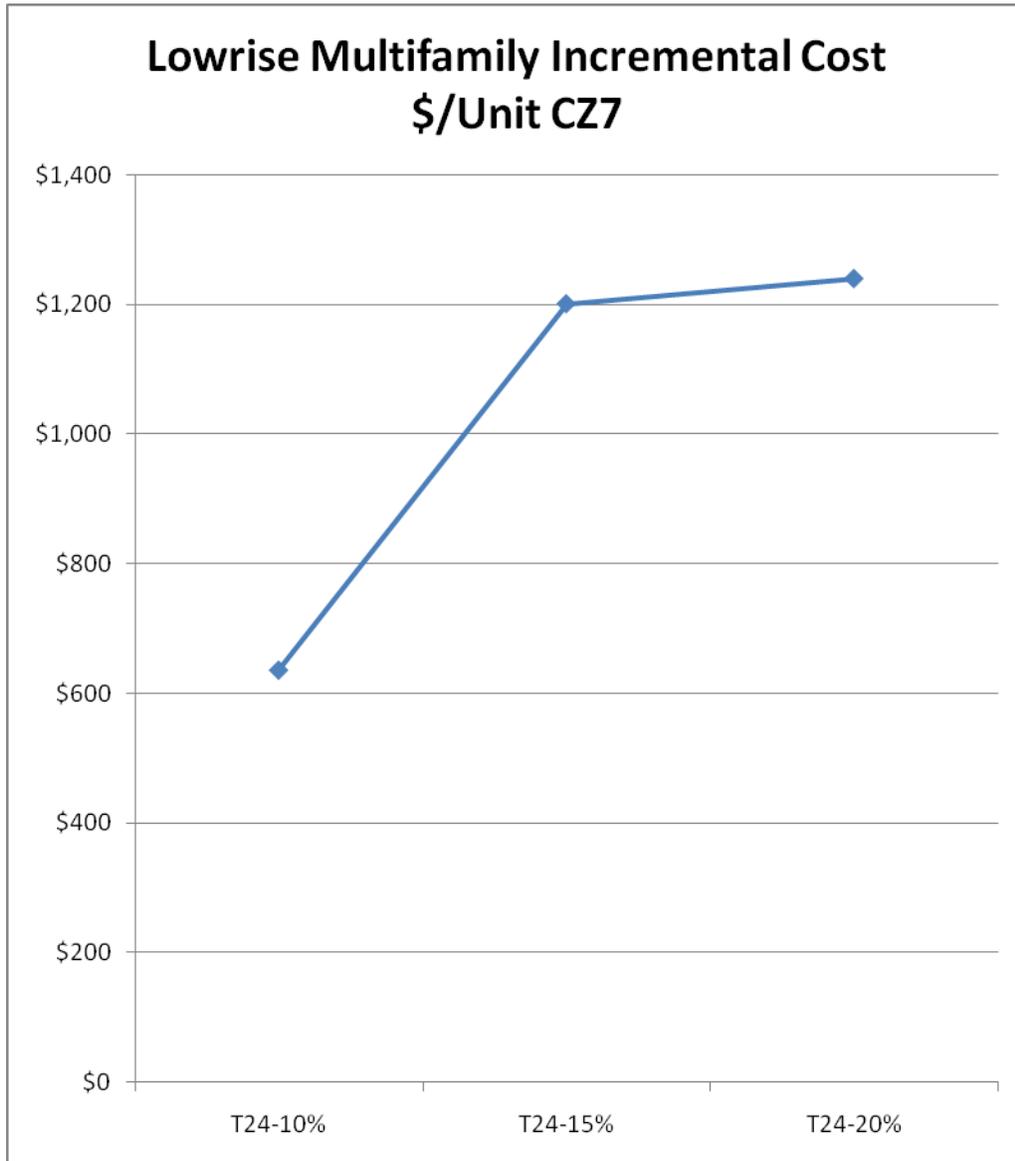


Figure 3-CZ7b-1: Added First Cost/Sq.Ft., – 2,025 sf 2-Story Single Family Home

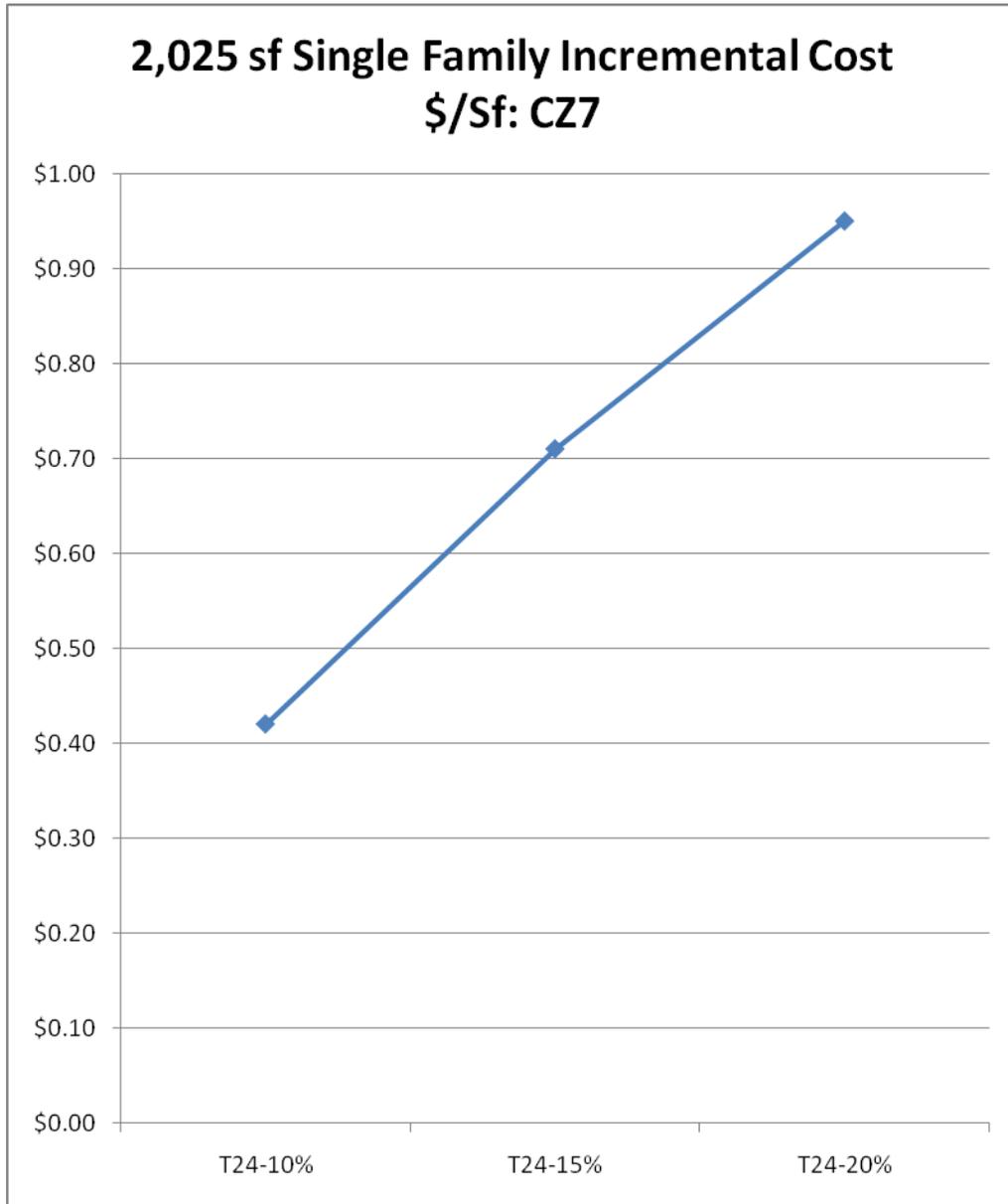


Figure 3-CZ7b-2: Added First Cost/Sq.Ft., – 2,975 sf 2-Story Single Family Home

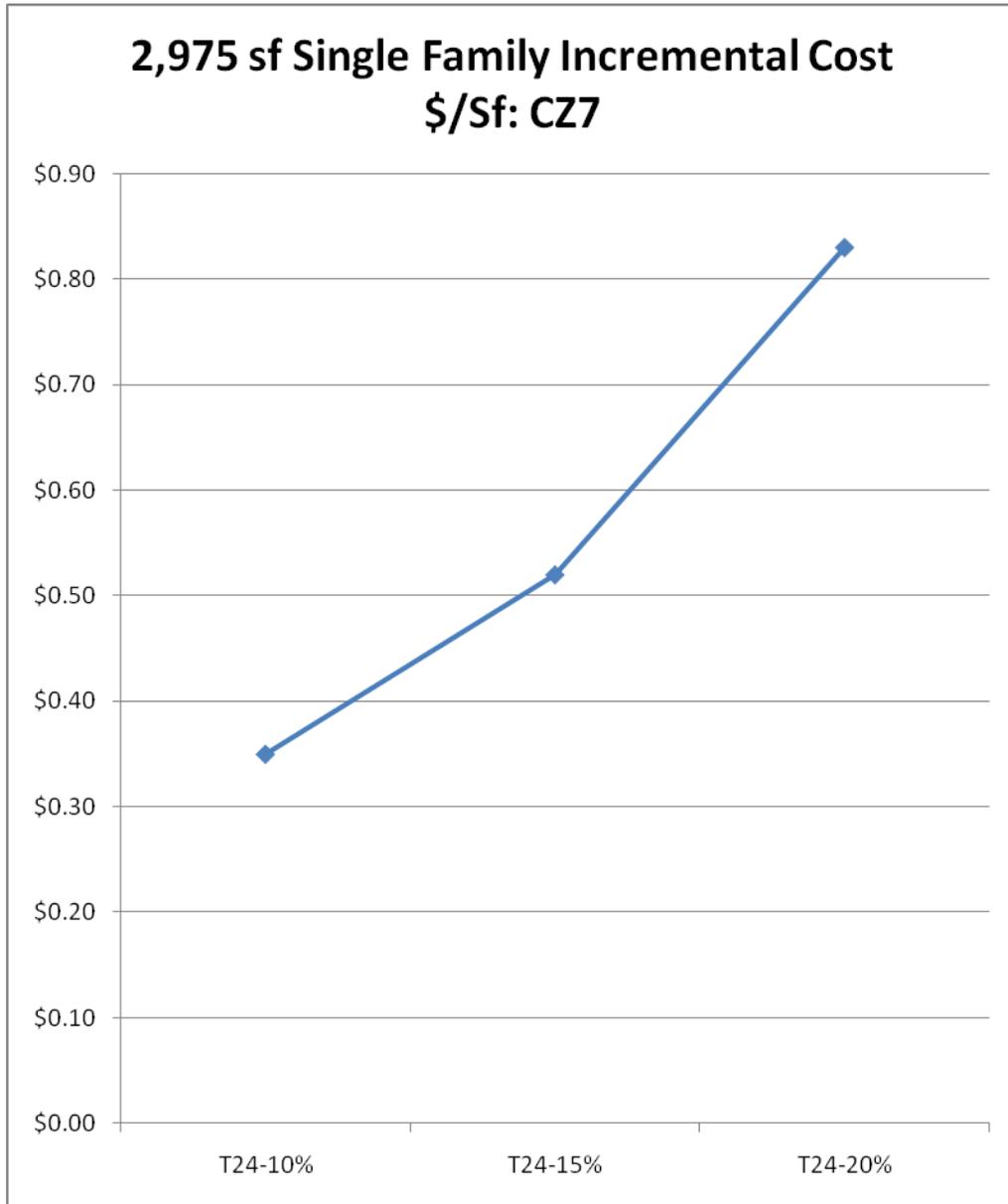
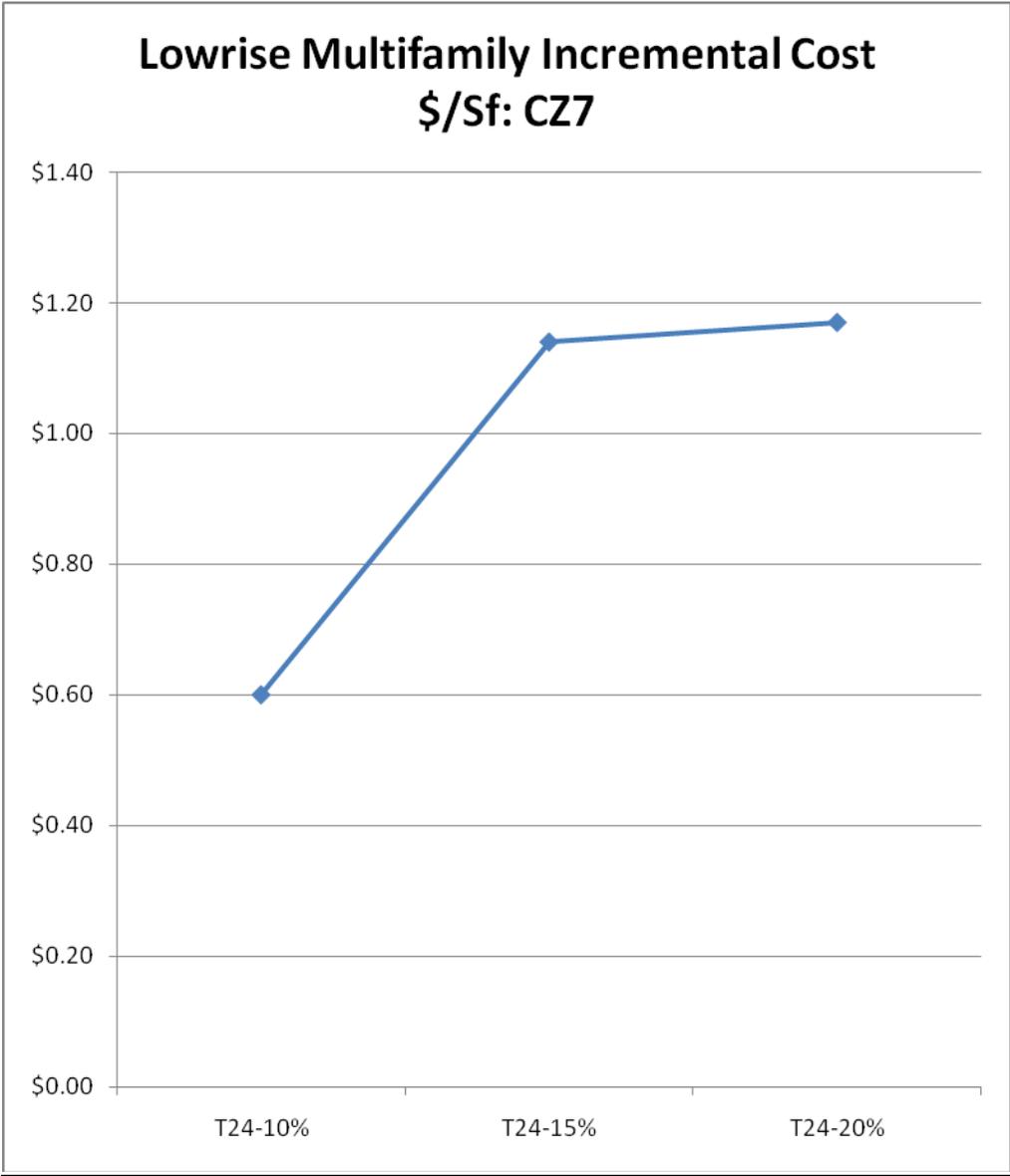
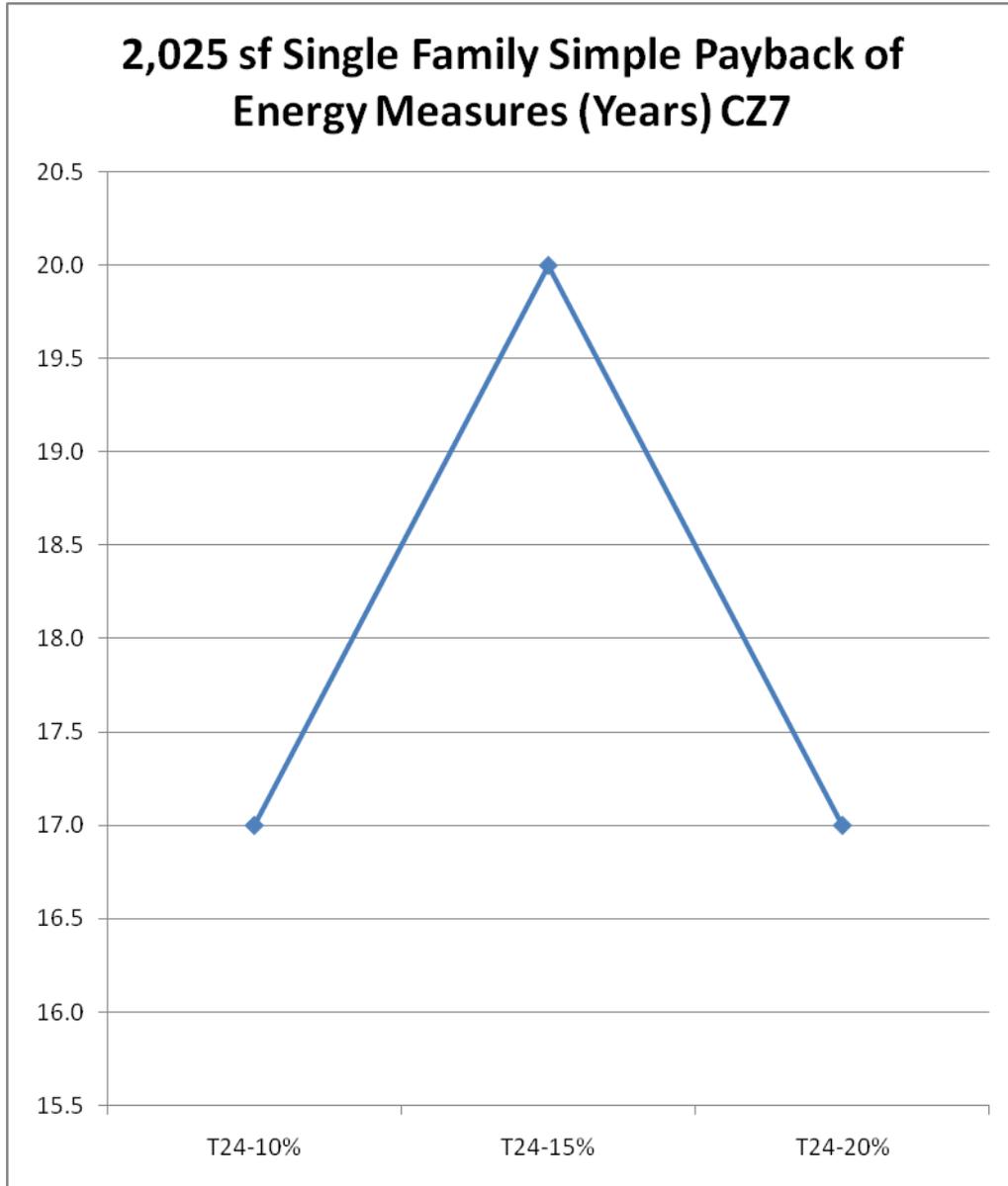


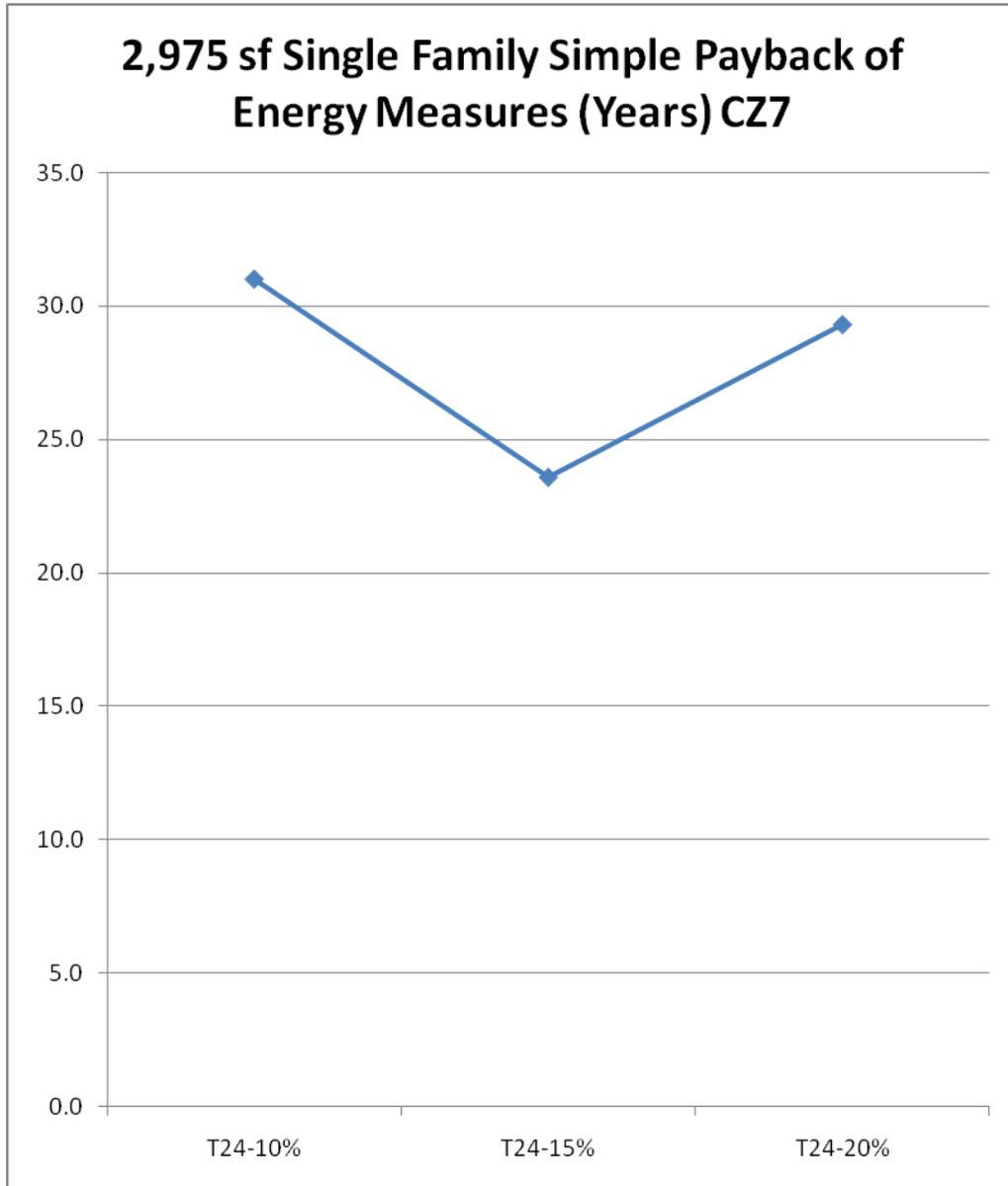
Figure 3-CZ7b-3: Added First Cost/Sq.Ft, 2-Story Multifamily Building



**Figure 3-CZ7c-1: Simple Payback of Energy Measures
– 2,025 sf 2-Story Single Family Home**



**Figure 3-CZ7c-2: Simple Payback of Energy Measures
– 2,975 sf 2-Story Single Family Home**



**Figure 3-CZ7c-3: Simple Payback of Energy Measures
2-Story Multifamily Building**

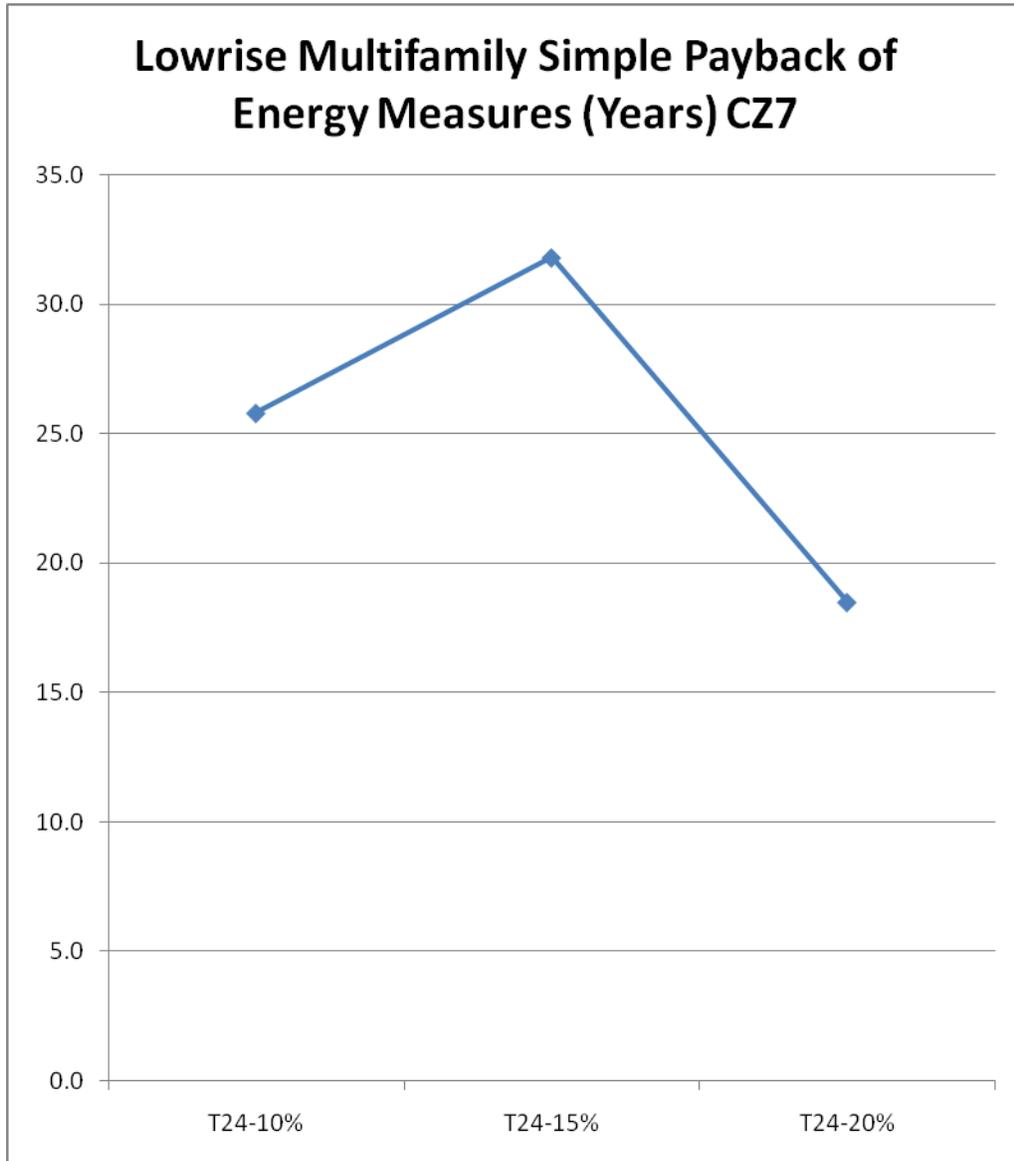
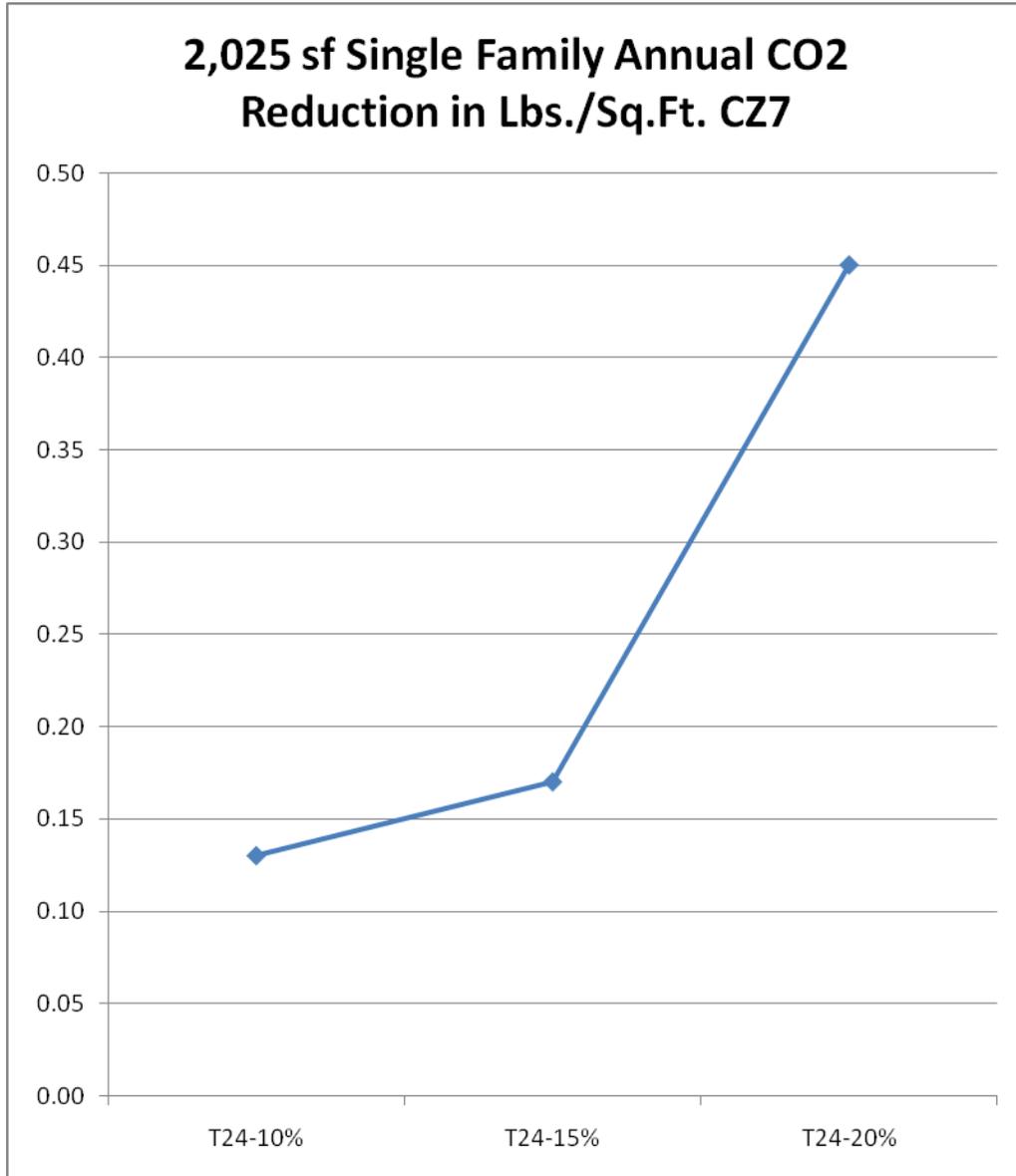
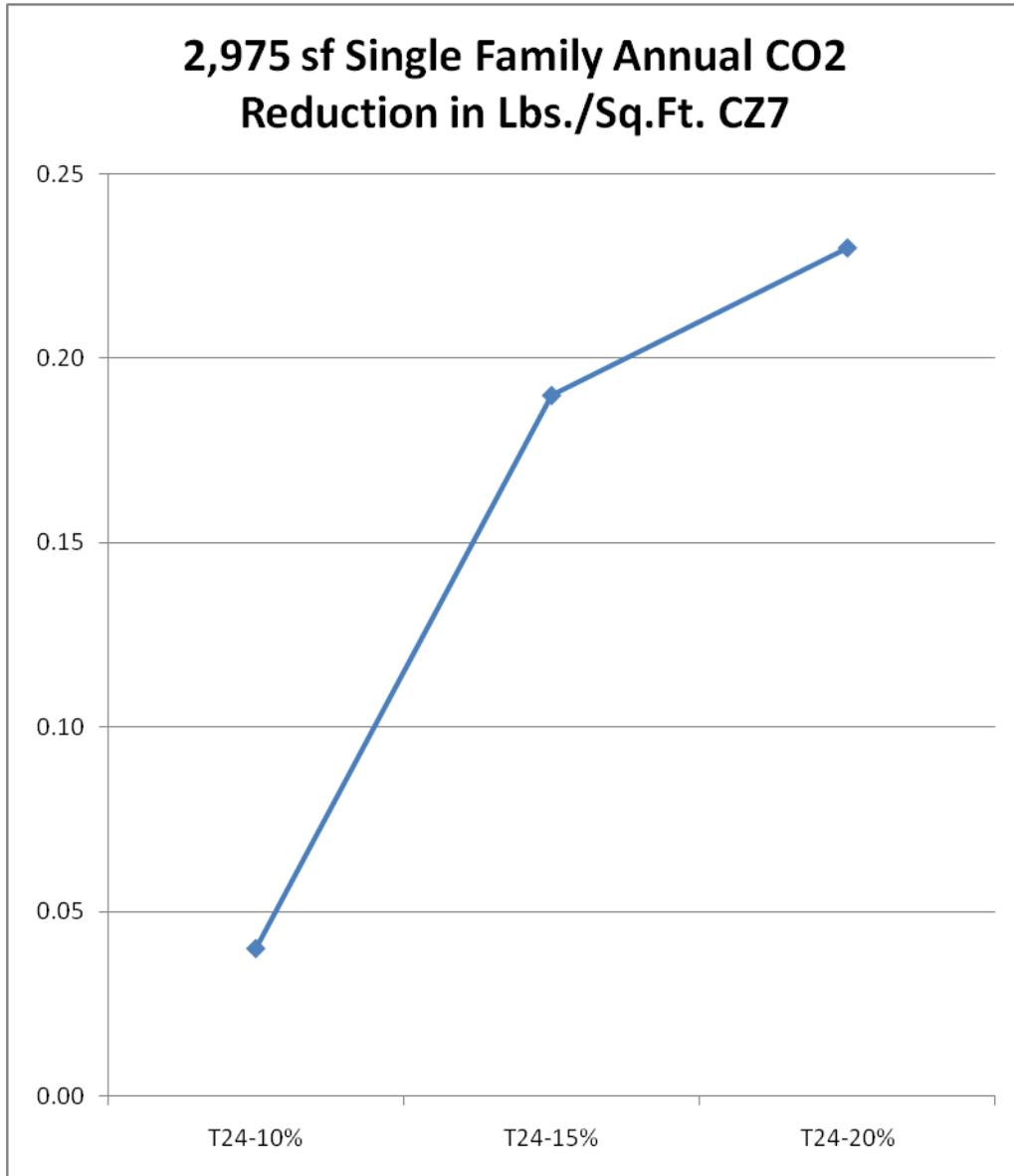


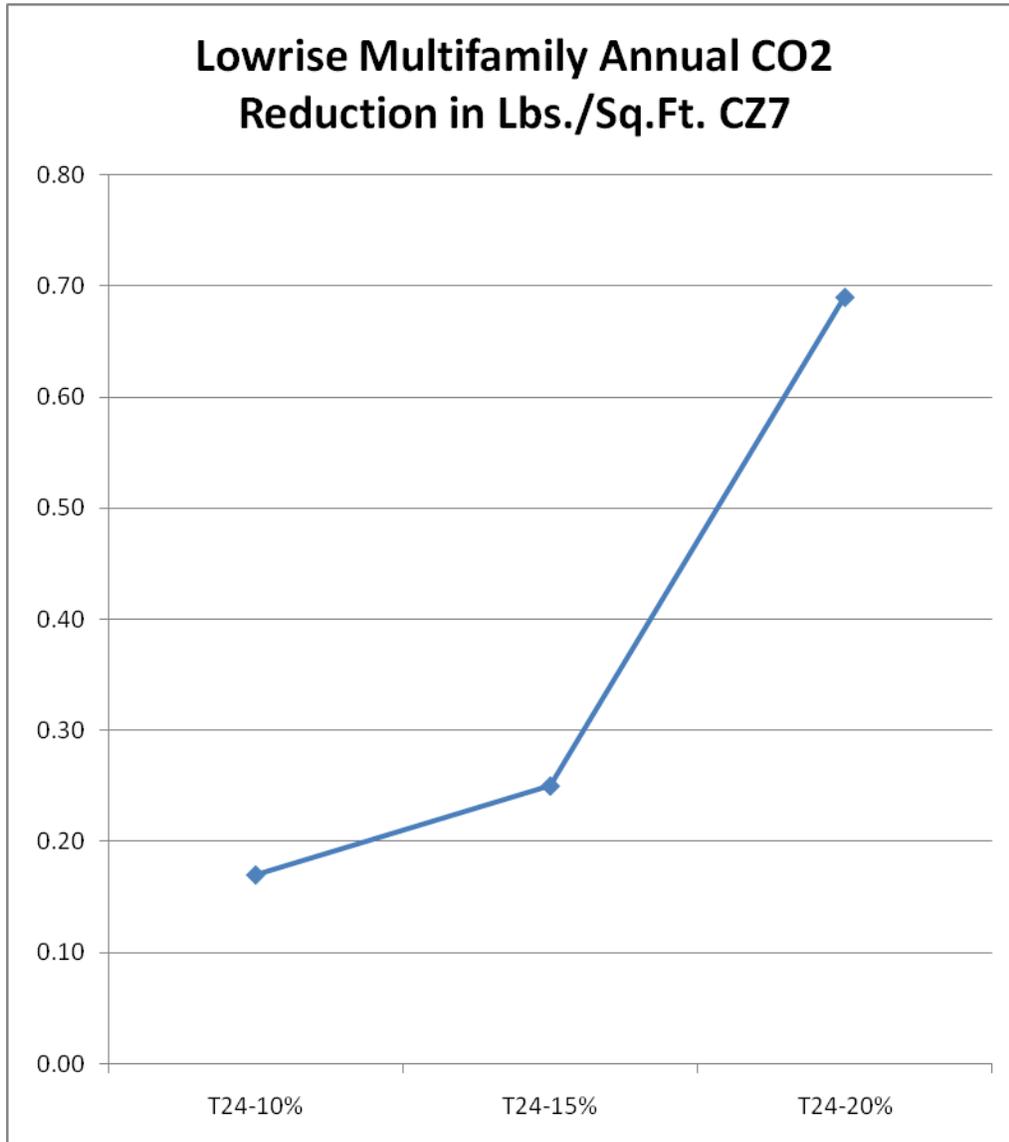
Figure 3-CZ7d-1: Annual Reduction in CO2 in Lbs./Sq.Ft. in Single Family – 2,025 sf 2-Story Single Family Home



**Figure 3-CZ7d-2: Annual Reduction in CO2 in Lbs./Sq.Ft. in Single Family
– 2,975 sf 2-Story Single Family Home**



**Figure 3-CZ7d-3: Annual Reduction in CO2 in Lbs./Sq.Ft.,
2-Story Multifamily Building**



High-rise Residential Building: Climate Zone 7

10% Better-than-Title 24

The following high-rise residential case study data is based on exceeding the 2008 Title 24 Standards by 10% in Climate Zone 7 as outlined in Section 2.3:

| | |
|---|-------------------------------|
| Average Incremental Cost per Dwelling Unit: | \$ 536 |
| Average Incremental Cost per Square Foot: | \$ 0.58 |
| Simple Payback of Incremental Energy Measures: | 12.5 years |
| Annual Reduction in CO2-equivalent: | 0.13 lbs./sq.ft.- year |

15% Better-than-Title 24

The following high-rise residential case study data is based on exceeding the 2008 Title 24 Standards by 15% in Climate Zone 7 as outlined in Section 2.3:

| | |
|---|-------------------------------|
| Average Incremental Cost per Dwelling Unit: | \$ 706 |
| Average Incremental Cost per Square Foot: | \$ 0.77 |
| Simple Payback of Incremental Energy Measures: | 11.7 years |
| Annual Reduction in CO2-equivalent: | 0.26 lbs./sq.ft.- year |

20% Better-than-Title 24

The following high-rise residential case study data is based on exceeding the 2008 Title 24 Standards by 20% in Climate Zone 7 as outlined in Section 2.3:

| | |
|---|-------------------------------|
| Average Incremental Cost per Dwelling Unit: | \$1,507 |
| Average Incremental Cost per Square Foot: | \$ 1.64 |
| Simple Payback of Incremental Energy Measures: | 16.7 years |
| Annual Reduction in CO2-equivalent: | 0.23 lbs./sq.ft.- year |

Figure 3-CZ7a-4: Added First Cost/Dwelling Unit, High-rise Residential Building

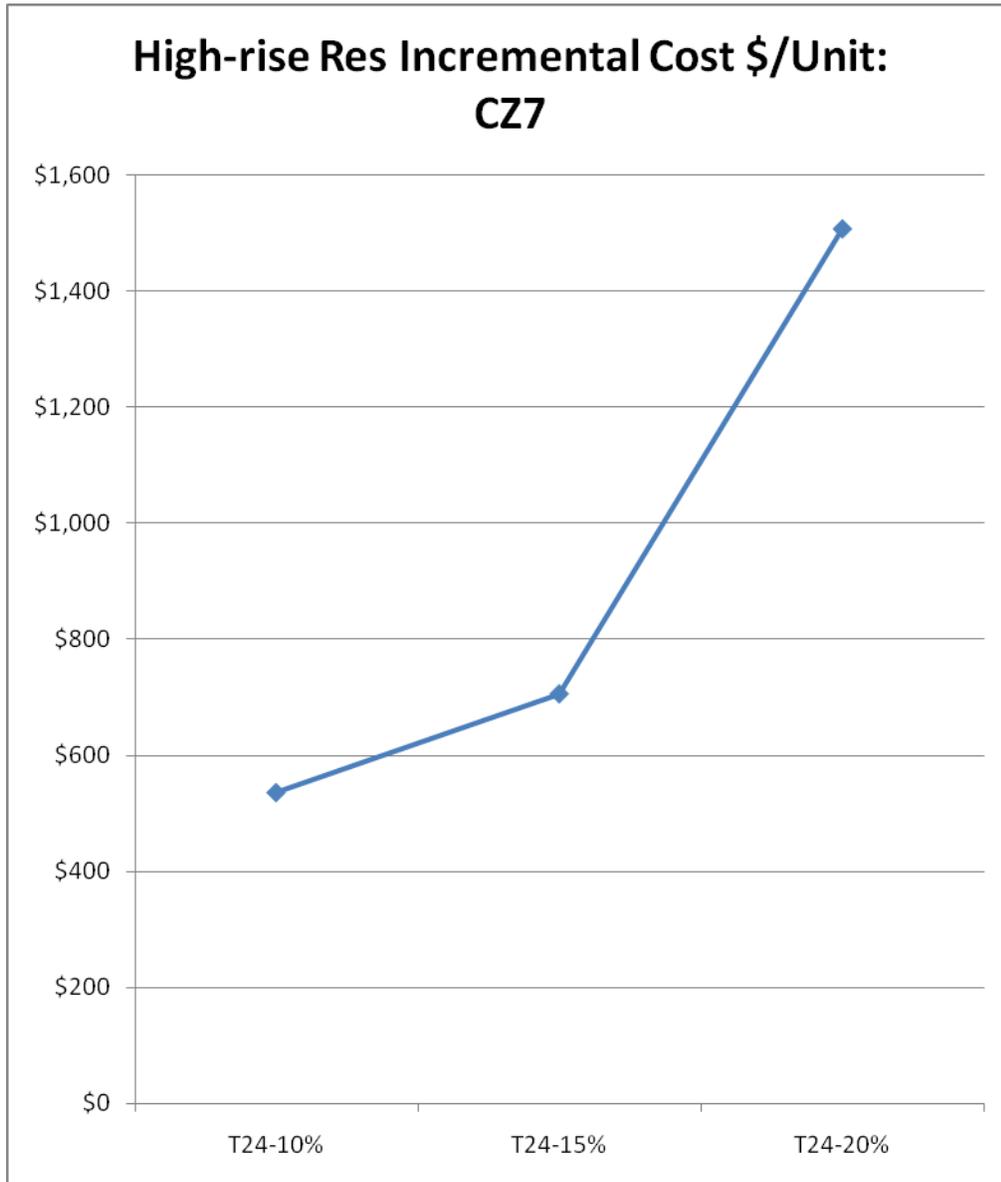


Figure 3-CZ7b-4: Added First Cost/Sq.Ft., High-rise Residential Building

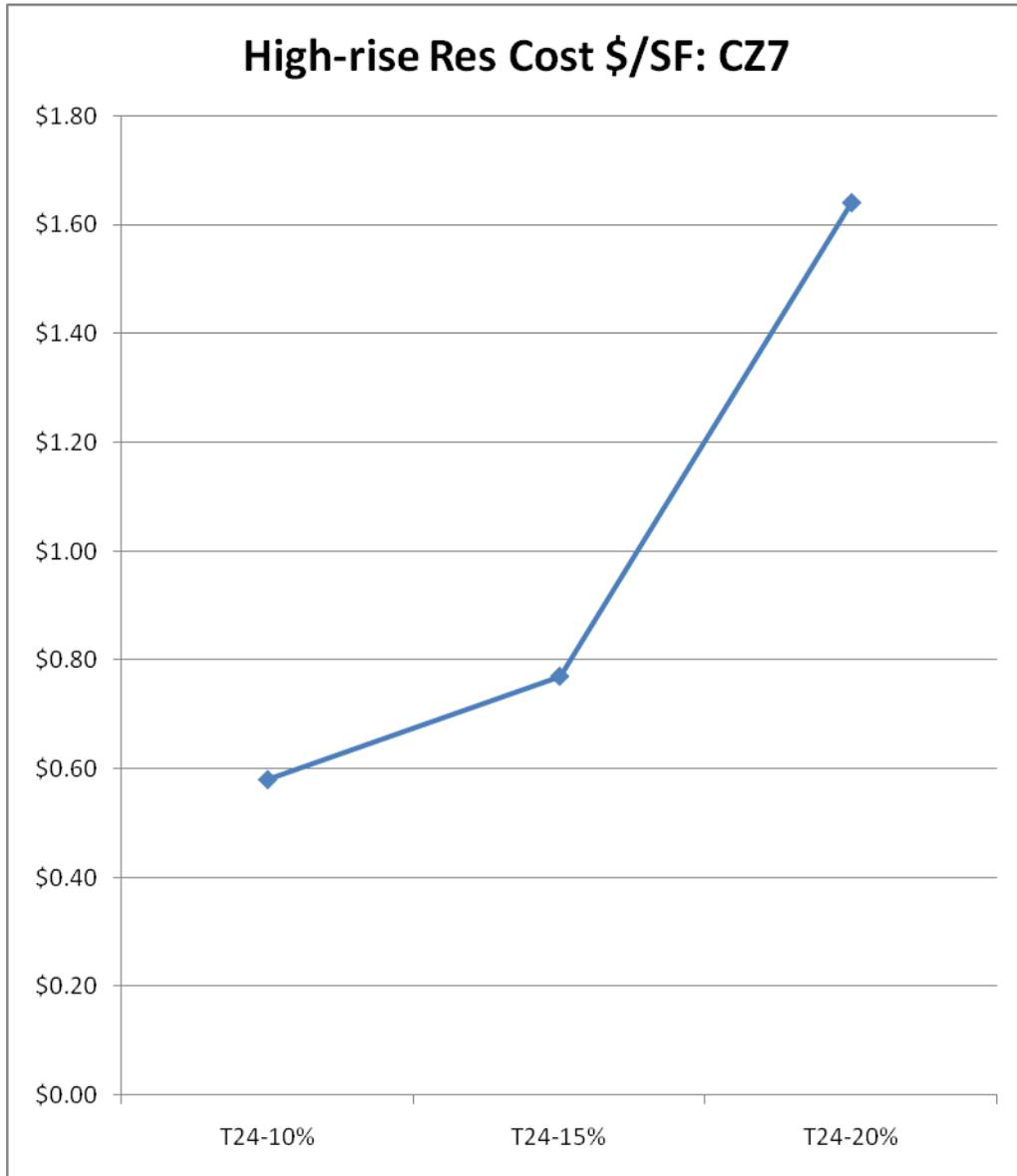


Figure 3-CZ7c-4: Simple Payback of Energy Measures, High-rise Residential Building

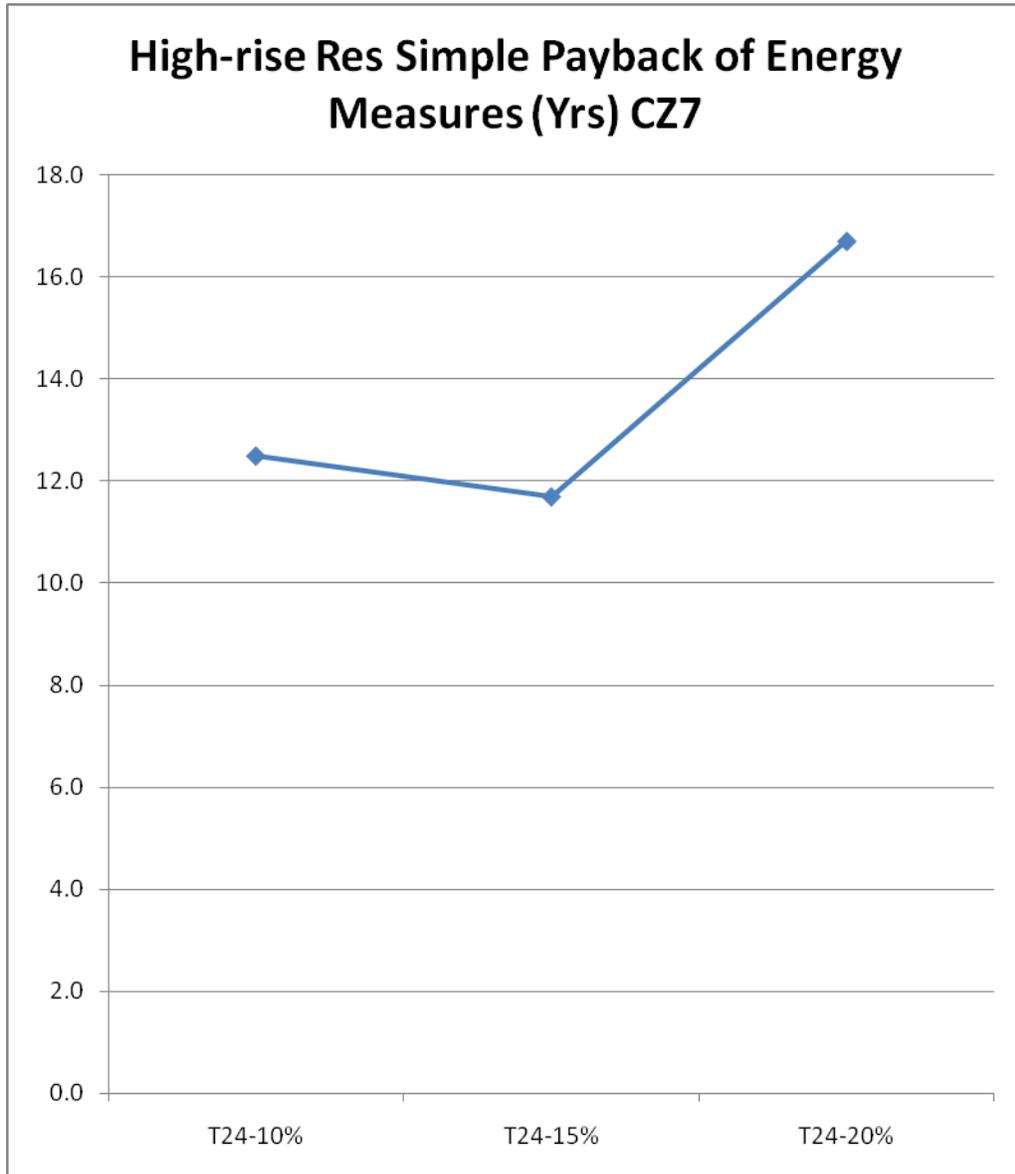
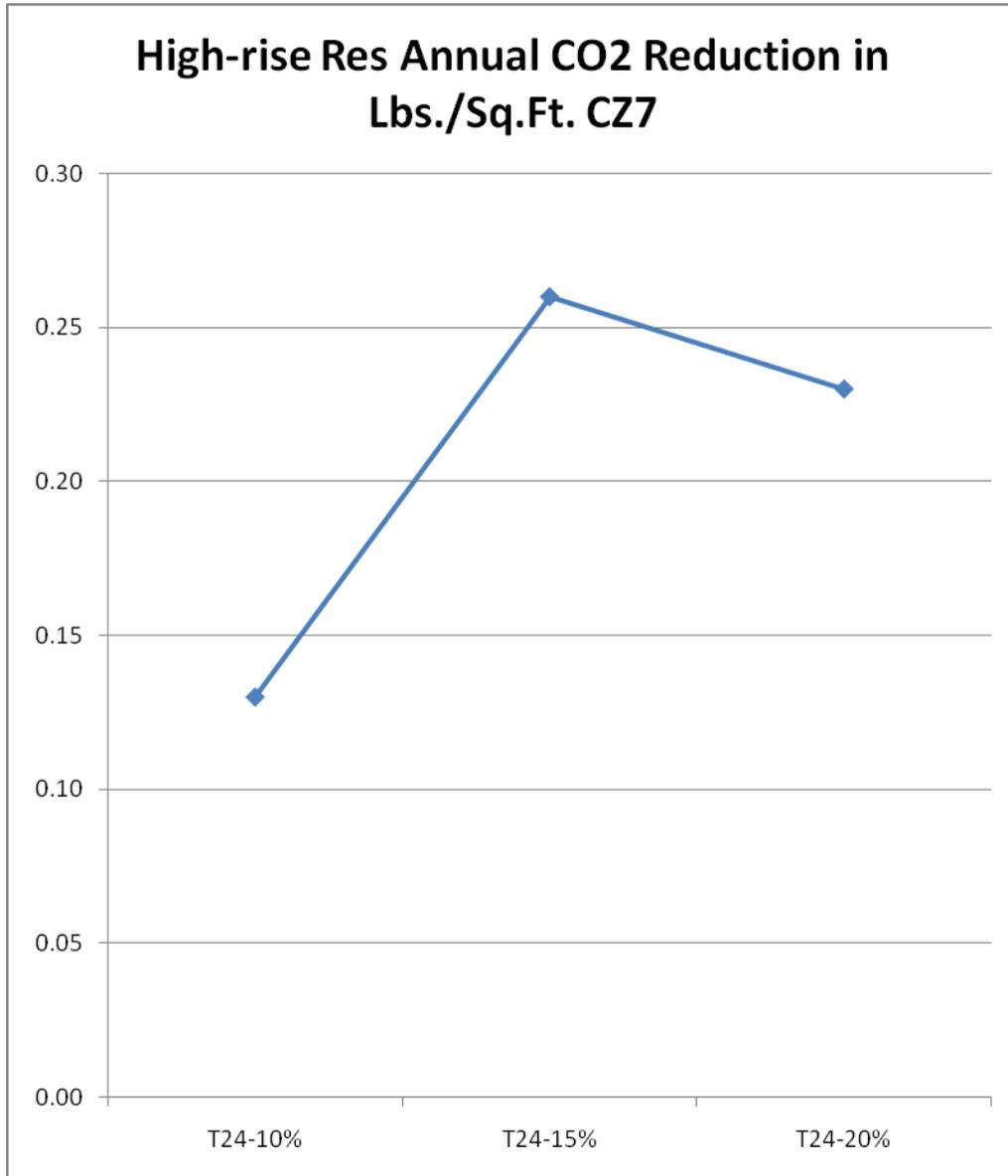


Figure 3-CZ7d-4: Annual Reduction in CO2 in Lbs./Sq.Ft., High-rise Residential Building



Nonresidential Building: Climate Zone 7

10% Better-than-Title 24

The following nonresidential case study data is based on exceeding the 2008 Title 24 Standards by 10% in Climate Zone 7 as outlined in Section 2.4:

| | |
|---|-------------------------------|
| Average Incremental Cost per Building: | \$ 32,660 |
| Average Incremental Cost per Square Foot: | \$ 0.62 |
| Simple Payback of Incremental Energy Measures: | 4.6 years |
| Annual Reduction in CO2-equivalent: | 0.30 lbs./sq.ft.- year |

15% Better-than-Title 24

The following nonresidential case study data is based on exceeding the 2008 Title 24 Standards by 15% in Climate Zone 7 as outlined in Section 2.4:

| | |
|---|-------------------------------|
| Average Incremental Cost per Building: | \$ 92,973 |
| Average Incremental Cost per Square Foot: | \$ 1.76 |
| Simple Payback of Incremental Energy Measures: | 8.1 years |
| Annual Reduction in CO2-equivalent: | 0.55 lbs./sq.ft.- year |

20% Better-than-Title 24

The following nonresidential case study data is based on exceeding the 2008 Title 24 Standards by 20% in Climate Zone 7 using only one combination of measures as outlined in Section 2.4:

| | |
|---|-------------------------------|
| Incremental Cost per Building: | \$126,180 |
| Incremental Cost per Square Foot: | \$ 2.39 |
| Simple Payback of Incremental Energy Measures: | 8.5 years |
| Annual Reduction in CO2-equivalent: | 0.70 lbs./sq.ft.- year |

Figure 3-CZ7a-5: Added First Cost/Dwelling Unit, Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)

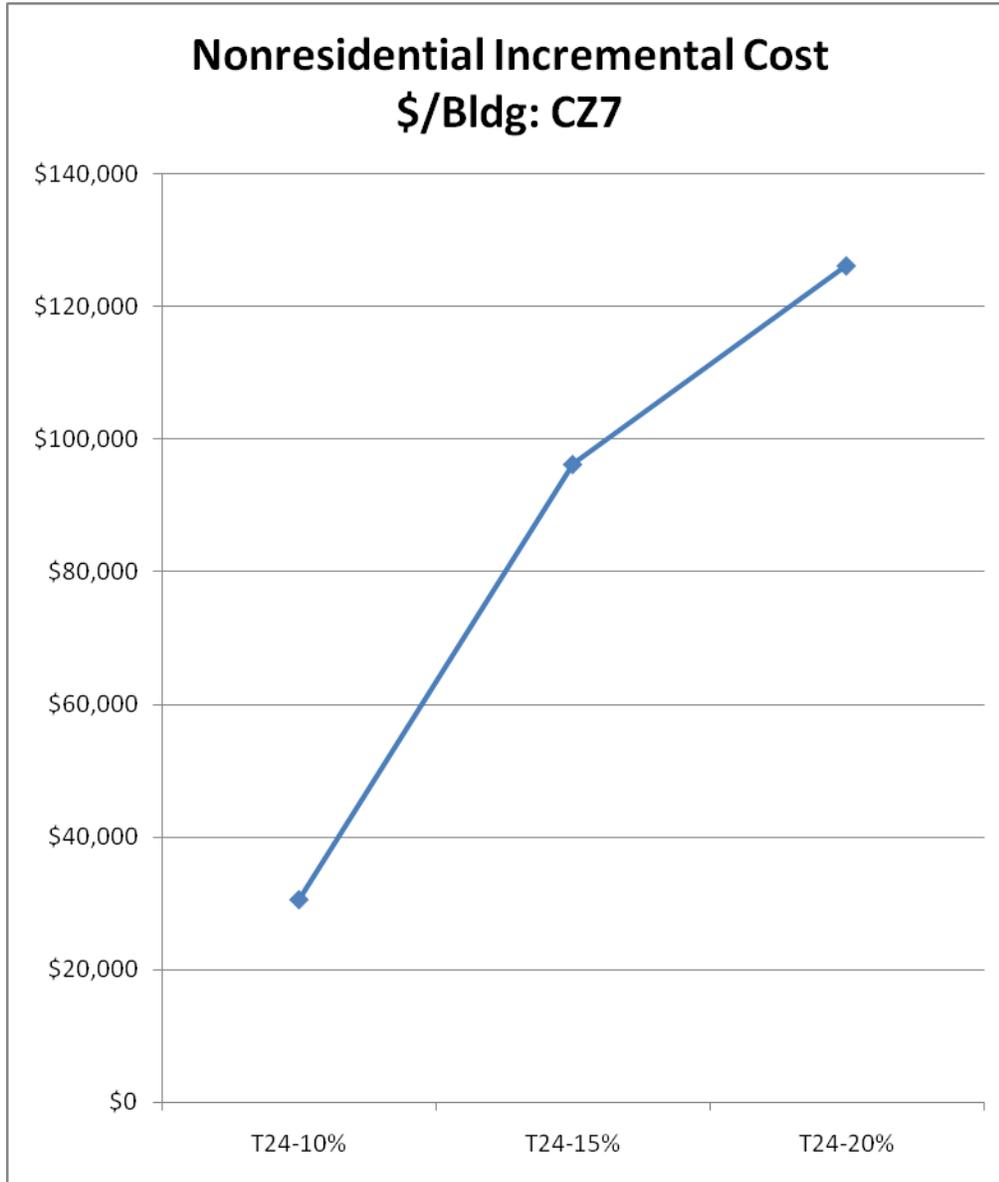


Figure 3-CZ7b-5: Added First Cost/Sq.Ft., Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)

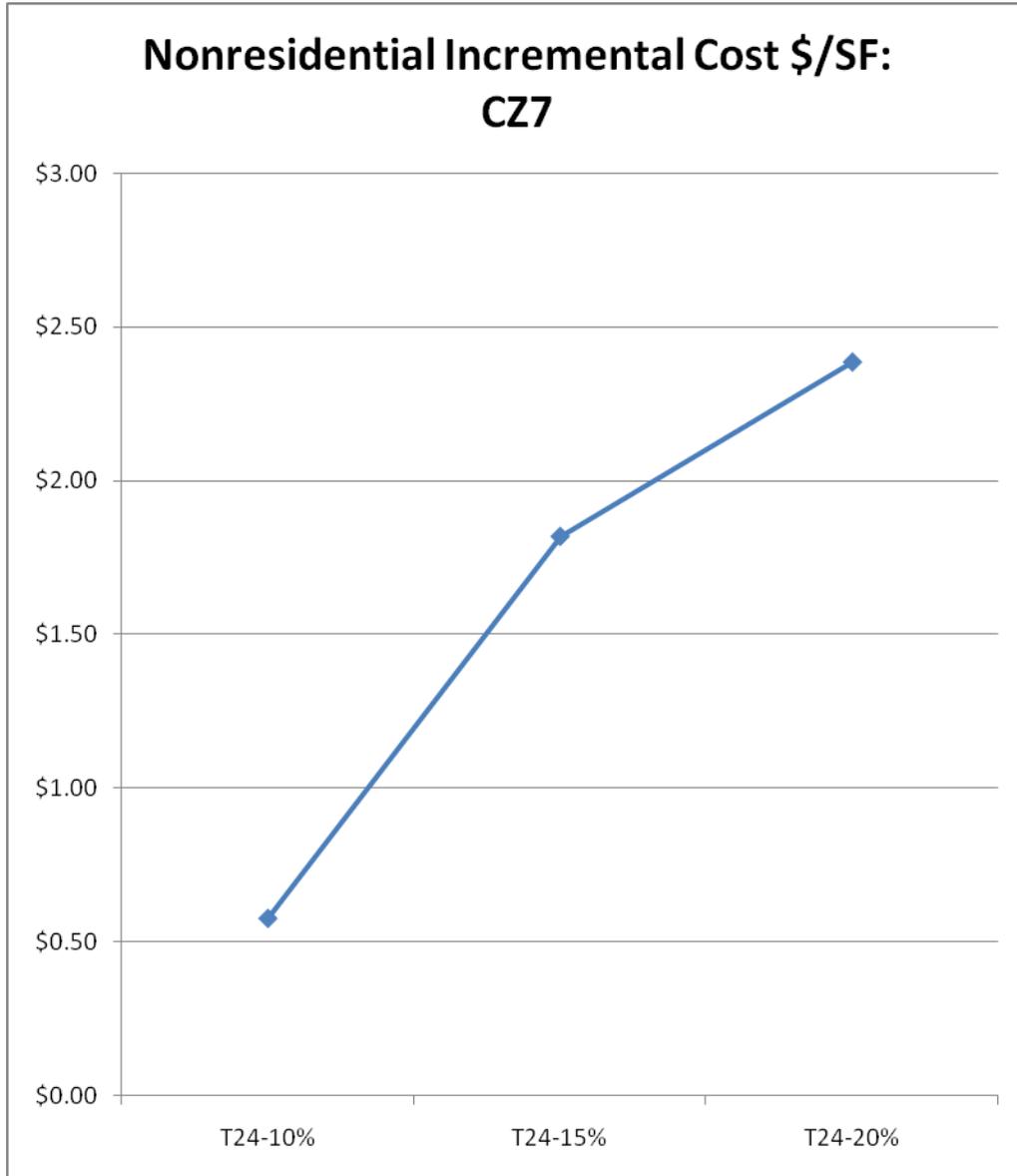


Figure 3-CZ7c-5: Simple Payback of Energy Measures, Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)

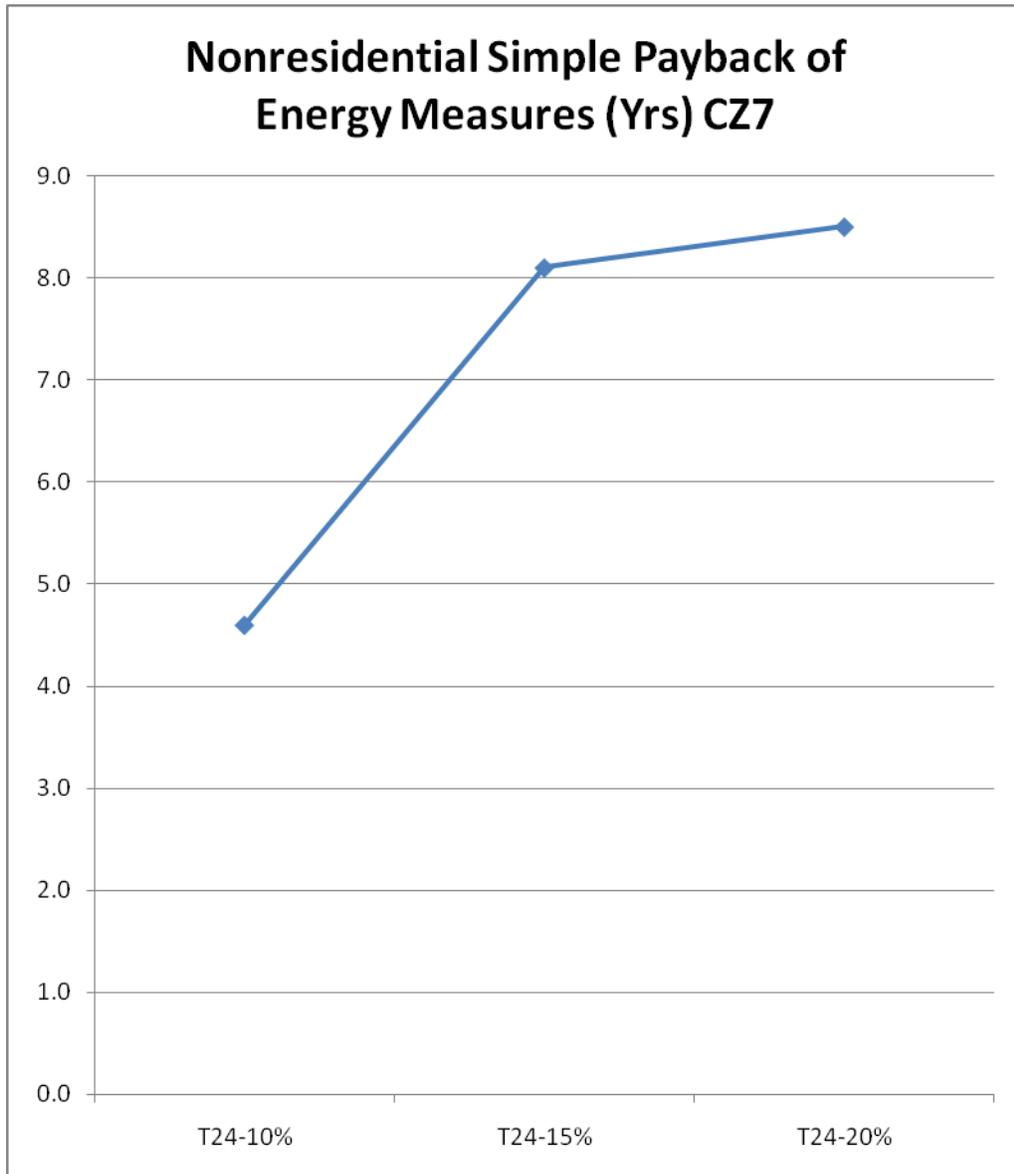
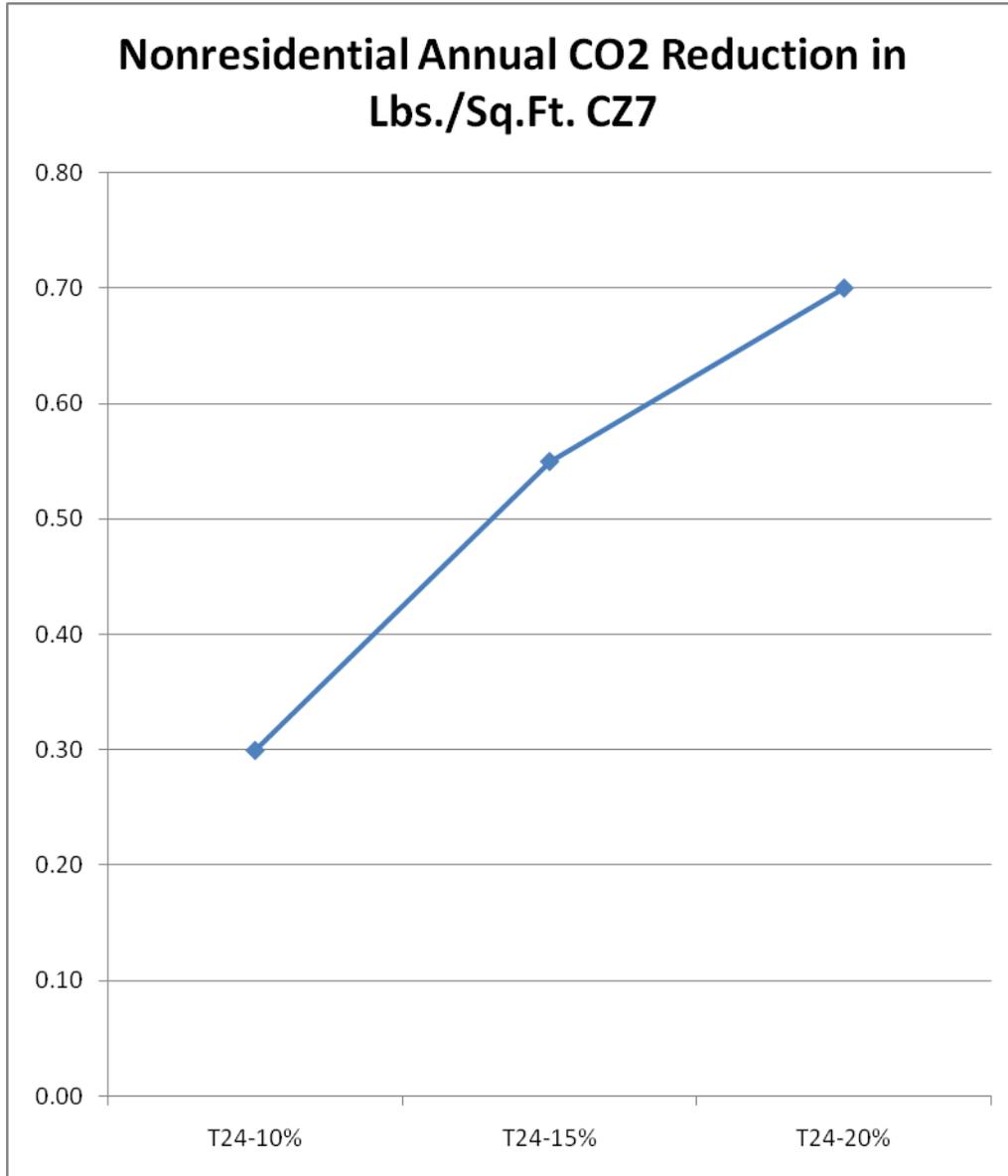


Figure 3-CZ7d-4: Annual Reduction in CO2 in Lbs./Sq.Ft., Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)



3.2 CLIMATE ZONE #10 RESULTS

Figure 3-CZ10a-1: Added First Cost – 2,025 sf 2-Story Single Family Home

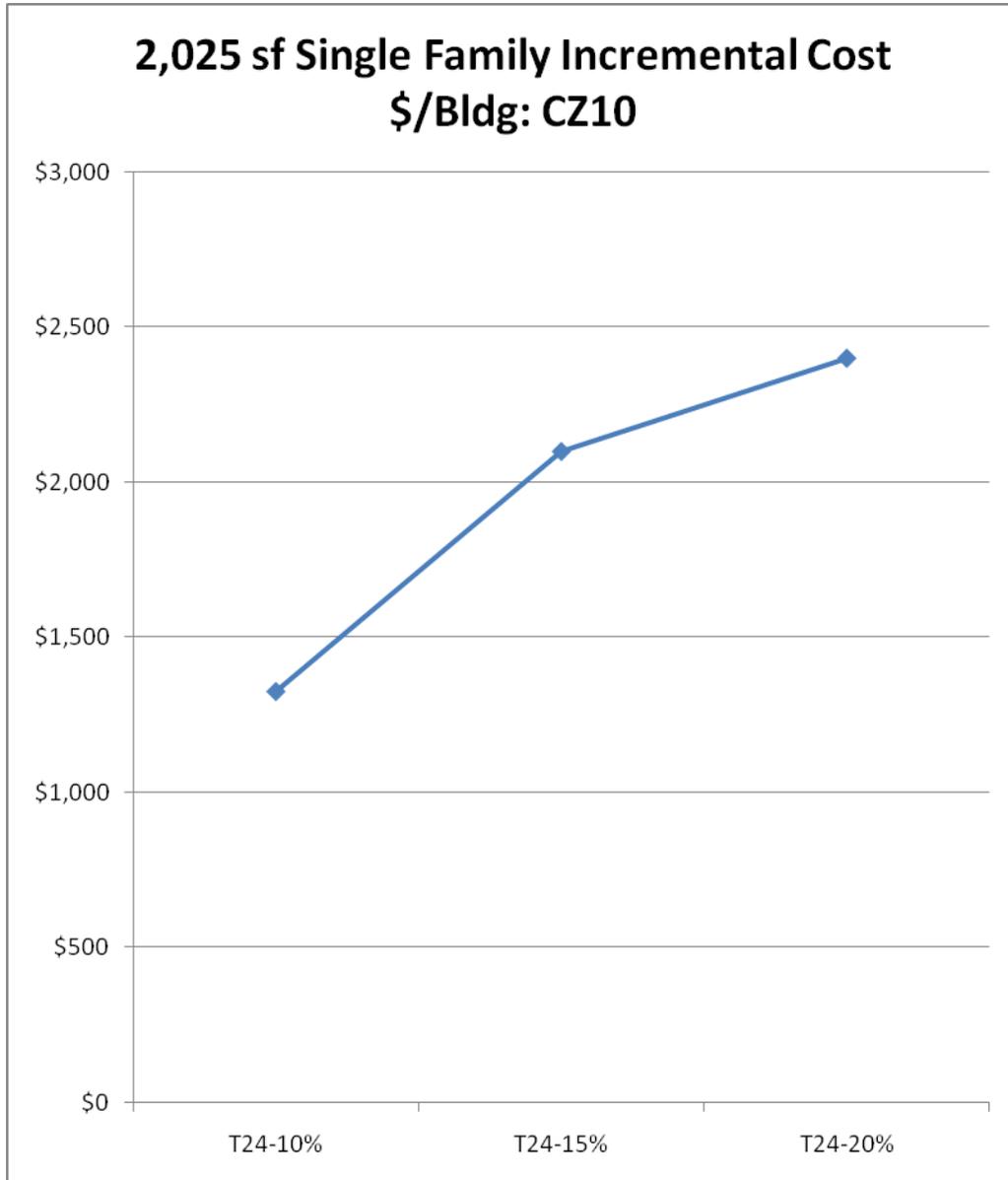
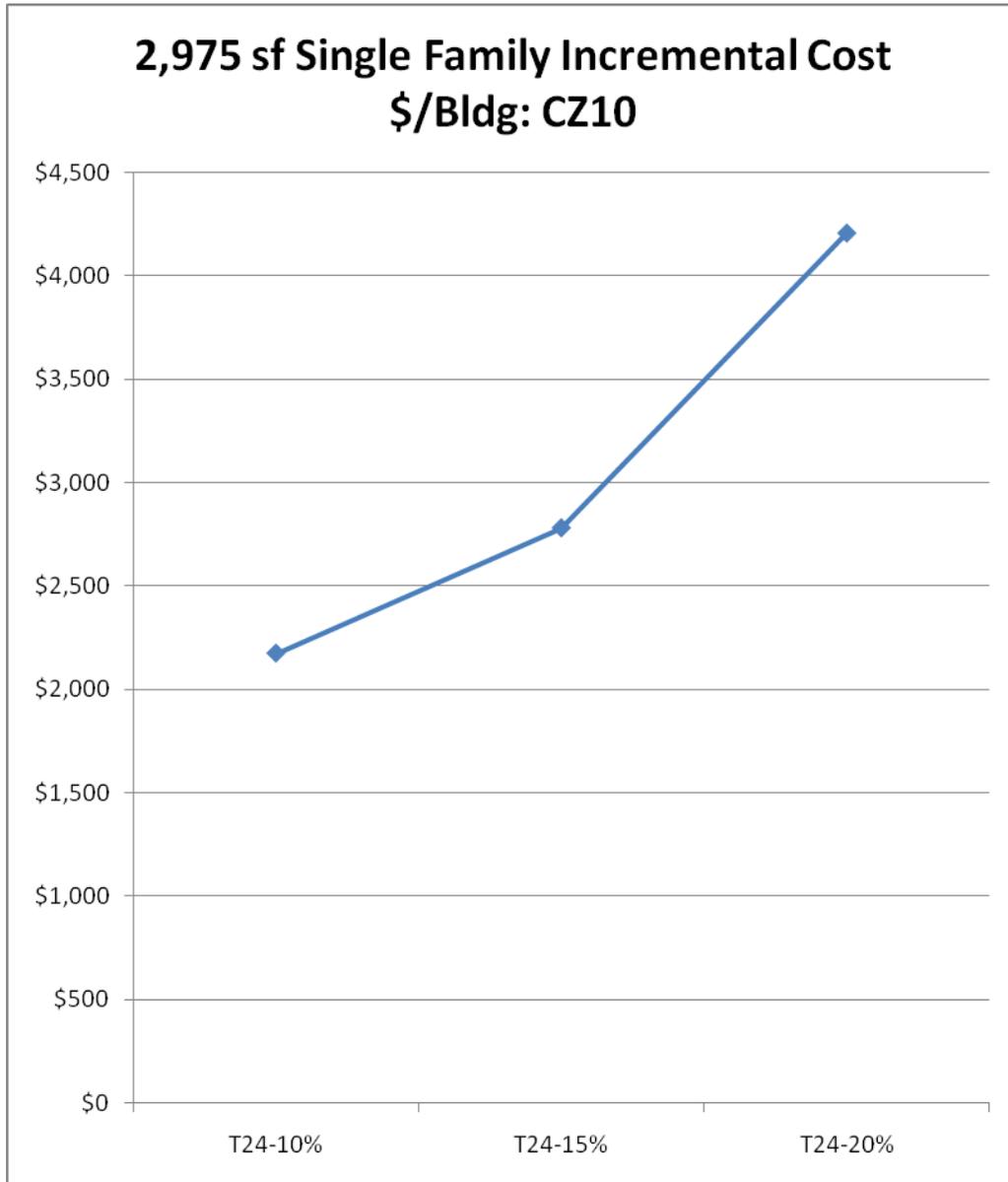


Figure 3-CZ10a-2: Added First Cost – 2,975 sf 2-Story Single Family Home



**Figure 3-CZ10a-3: Added First Cost/Dwelling Unit,
2-Story Multifamily Building**

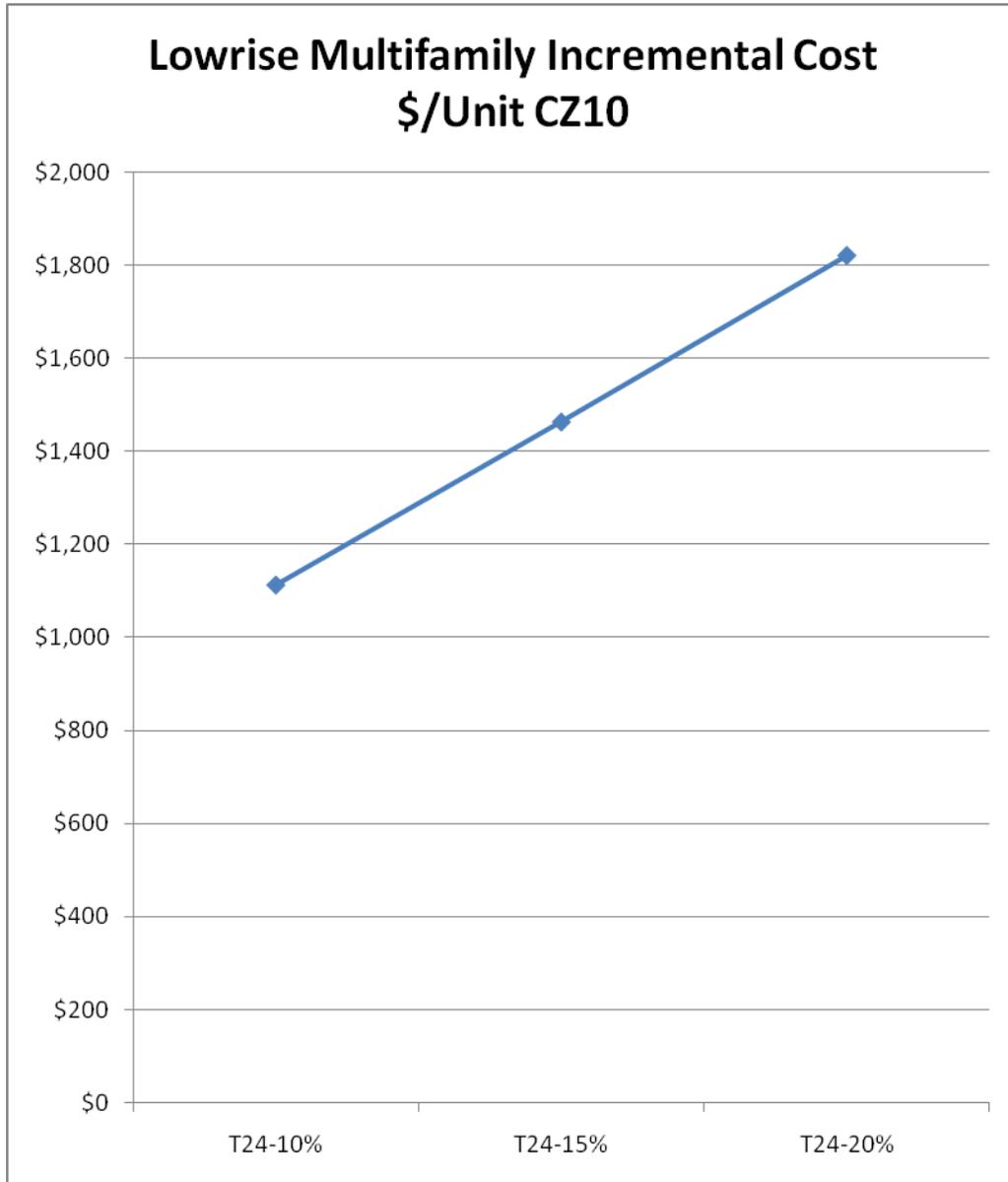
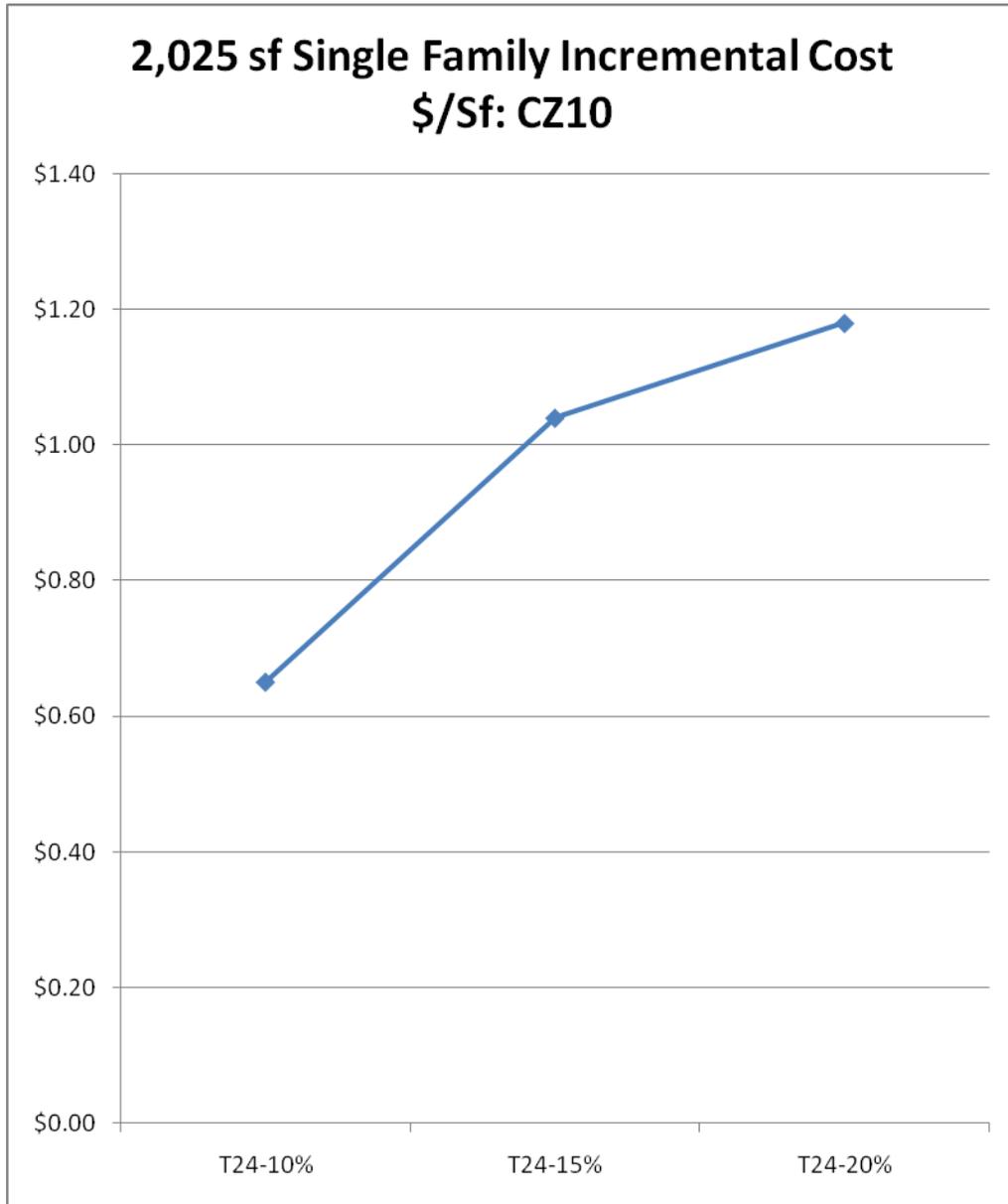
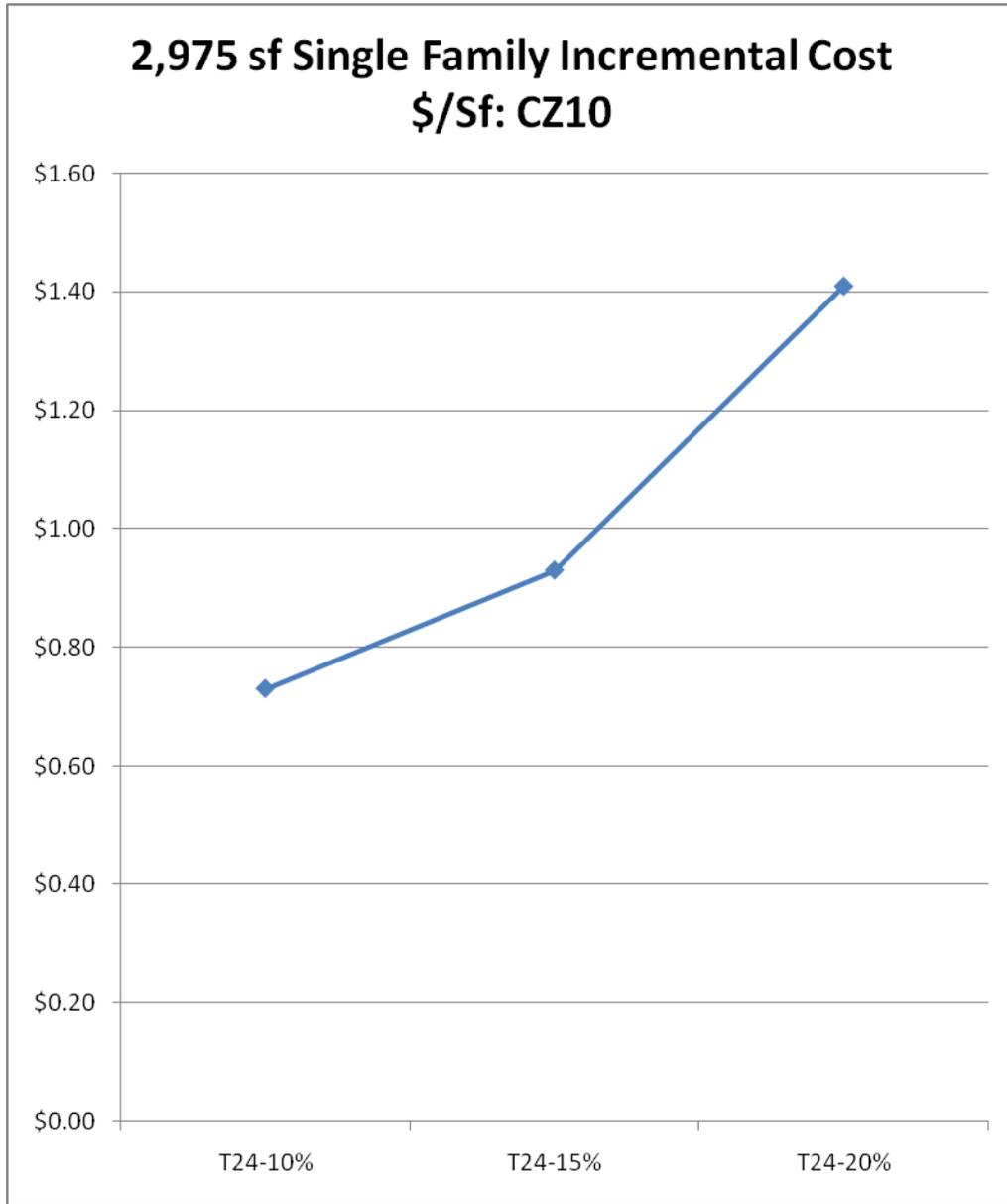


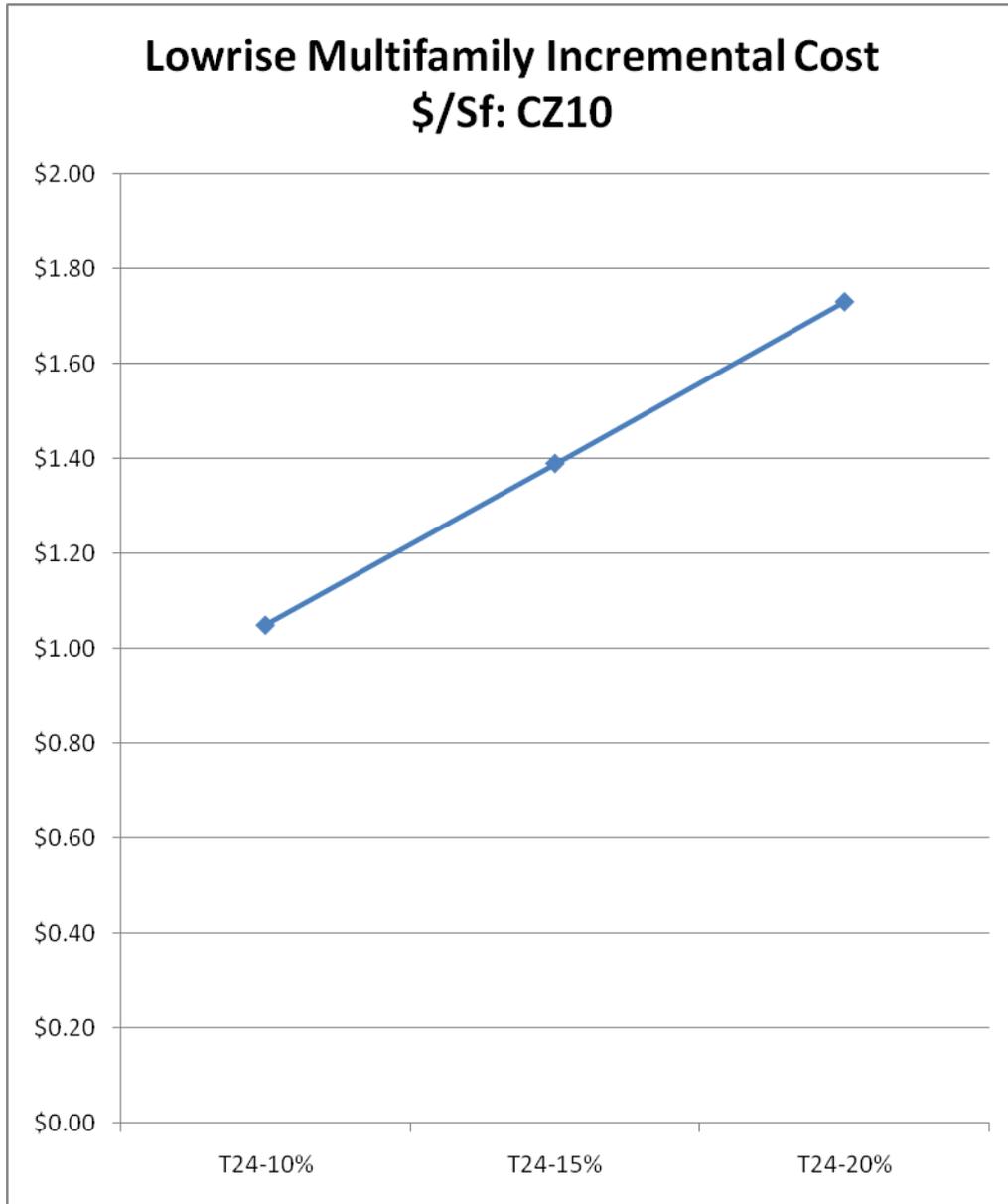
Figure 3-CZ10b-1: Added First Cost/Sq.Ft. – 2,025 sf 2-Story Single Family Home



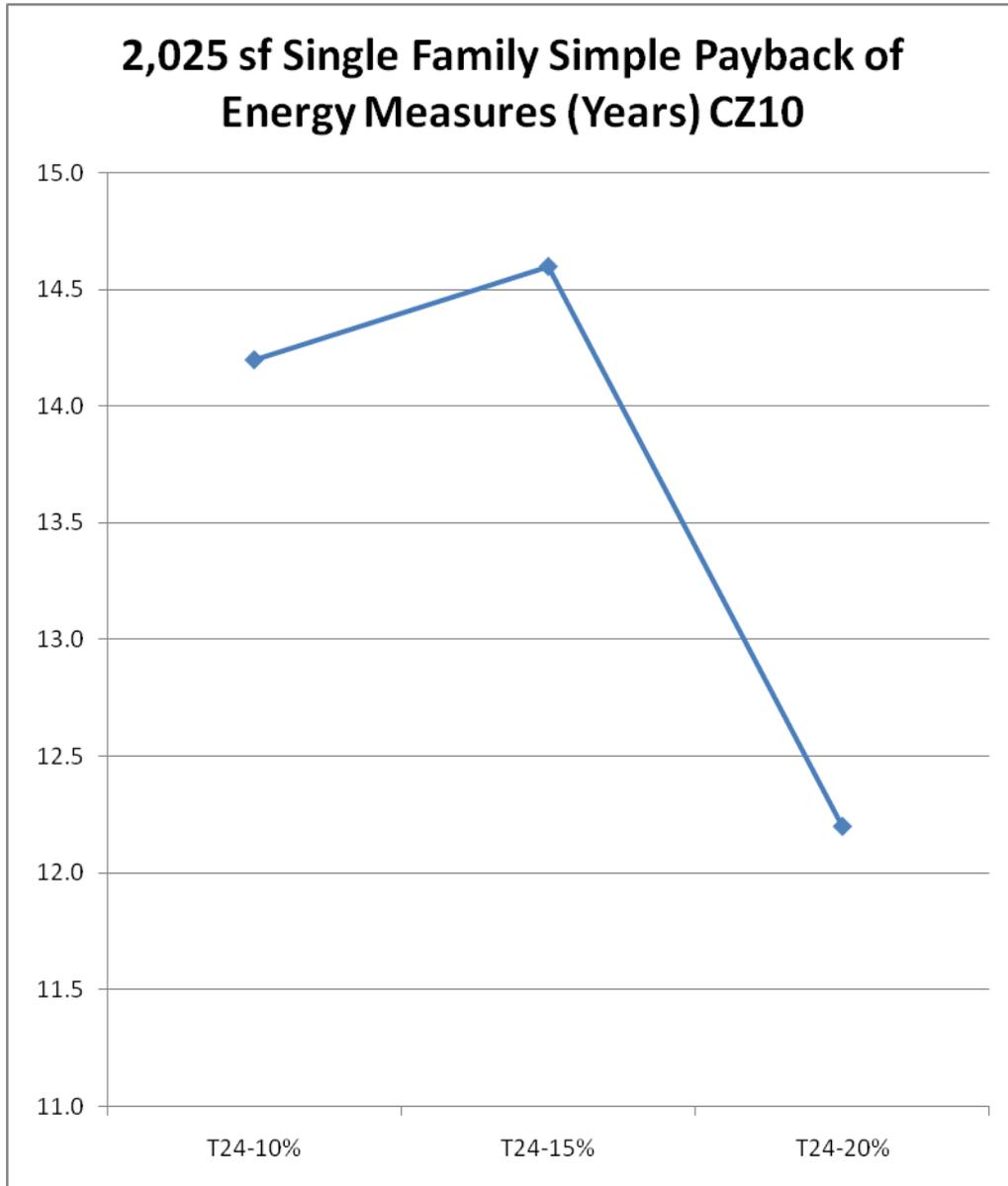
**Figure 3-CZ10b-2: Added First Cost/Sq.Ft.,
– 2,975 sf 2-Story Single Family Home**



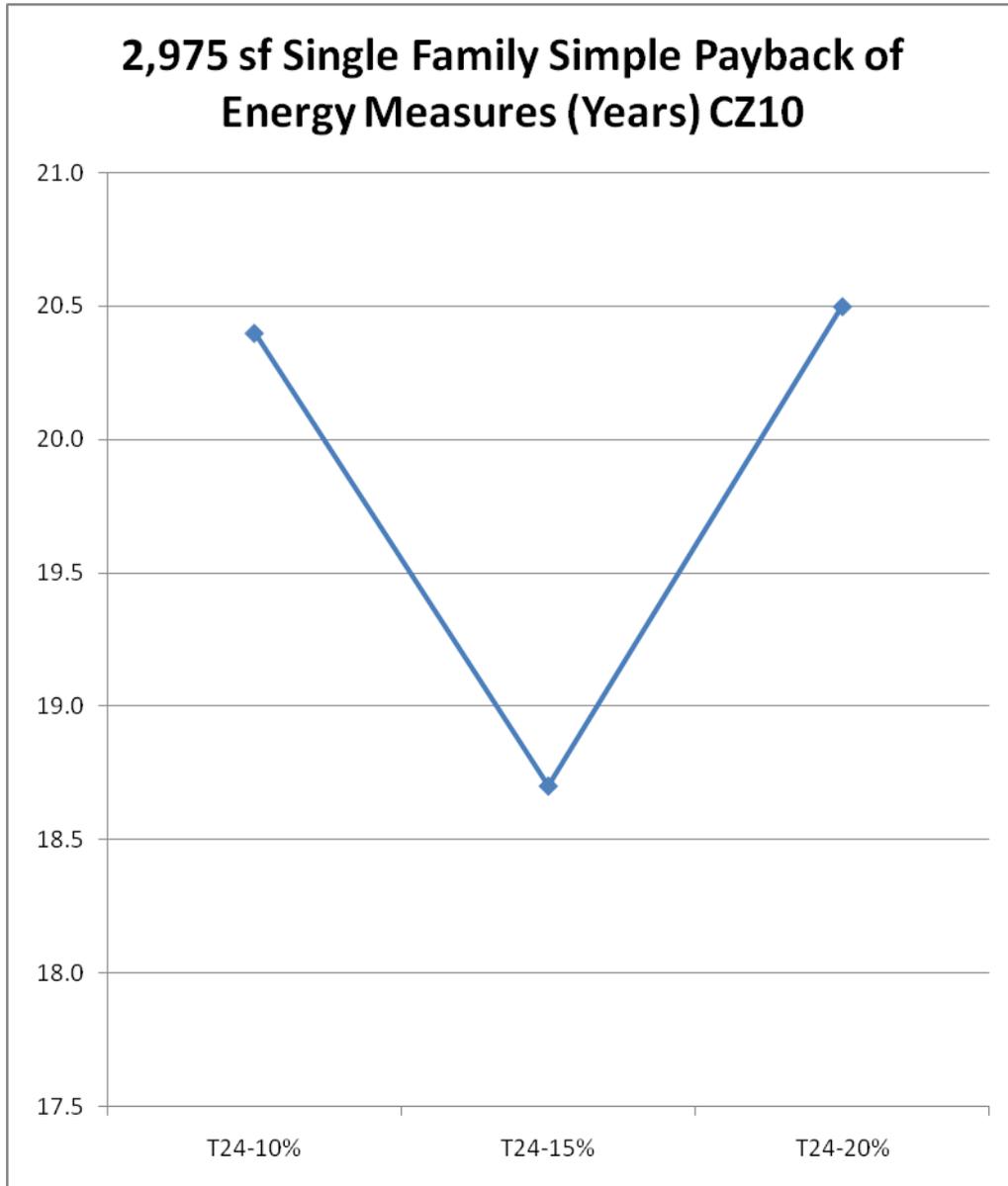
**Figure 3-CZ10b-3: Added First Cost/Sq.Ft.,
2-Story Multifamily Building**



**Figure 3-CZ10c-1: Simple Payback of Energy Measures
– 2,025 sf 2-Story Single Family Home**



**Figure 3-CZ10c-2: Simple Payback of Energy Measures
– 2,975 sf 2-Story Single Family Home**



**Figure 3-CZ10c-3: Simple Payback of Energy Measures
2-Story
Multifamily Building**

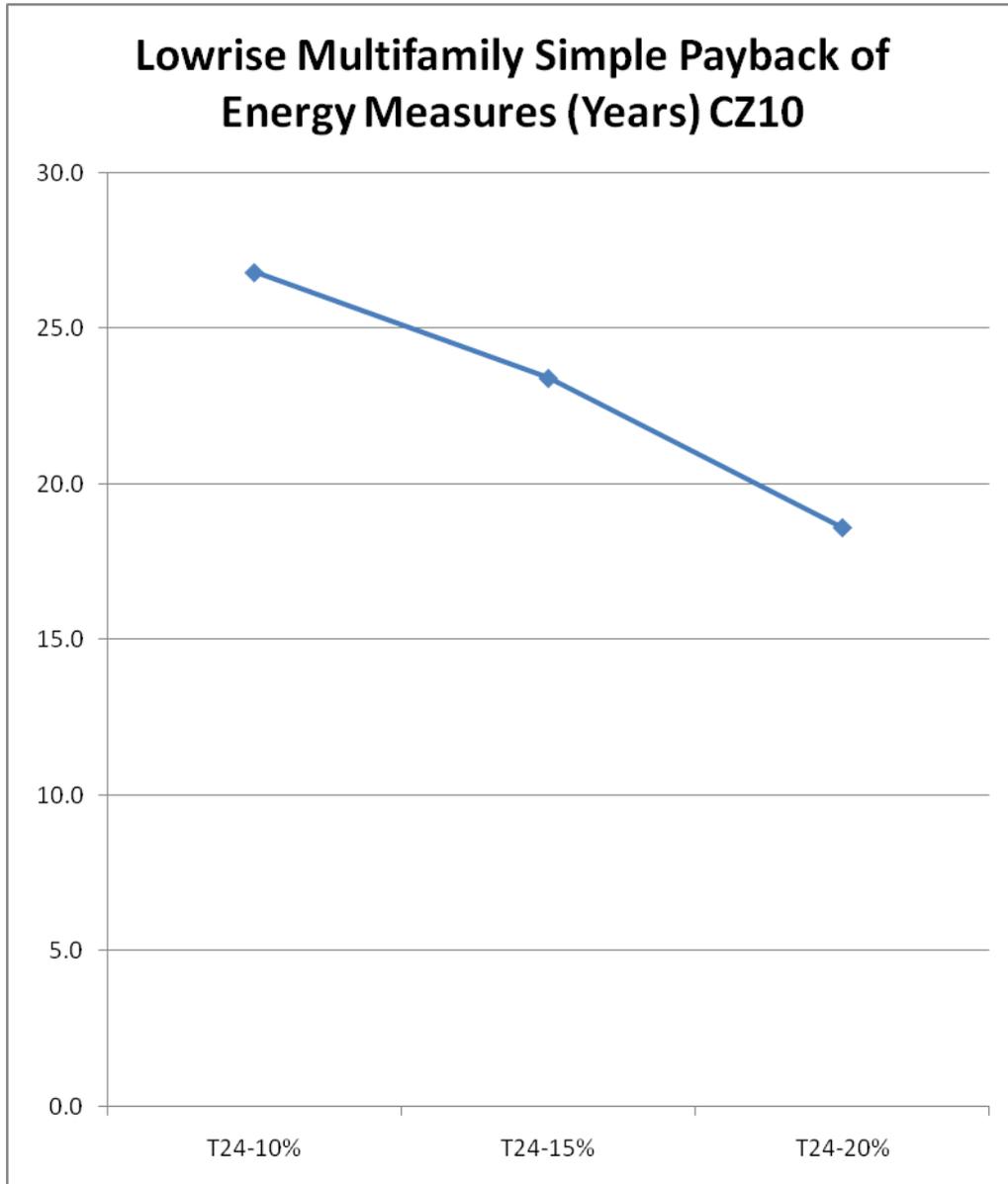


Figure 3-CZ10d-1: Annual Reduction in CO2 in Lbs./Sq.Ft. in Single Family, 2,025 sf 2-Story Single Family Home

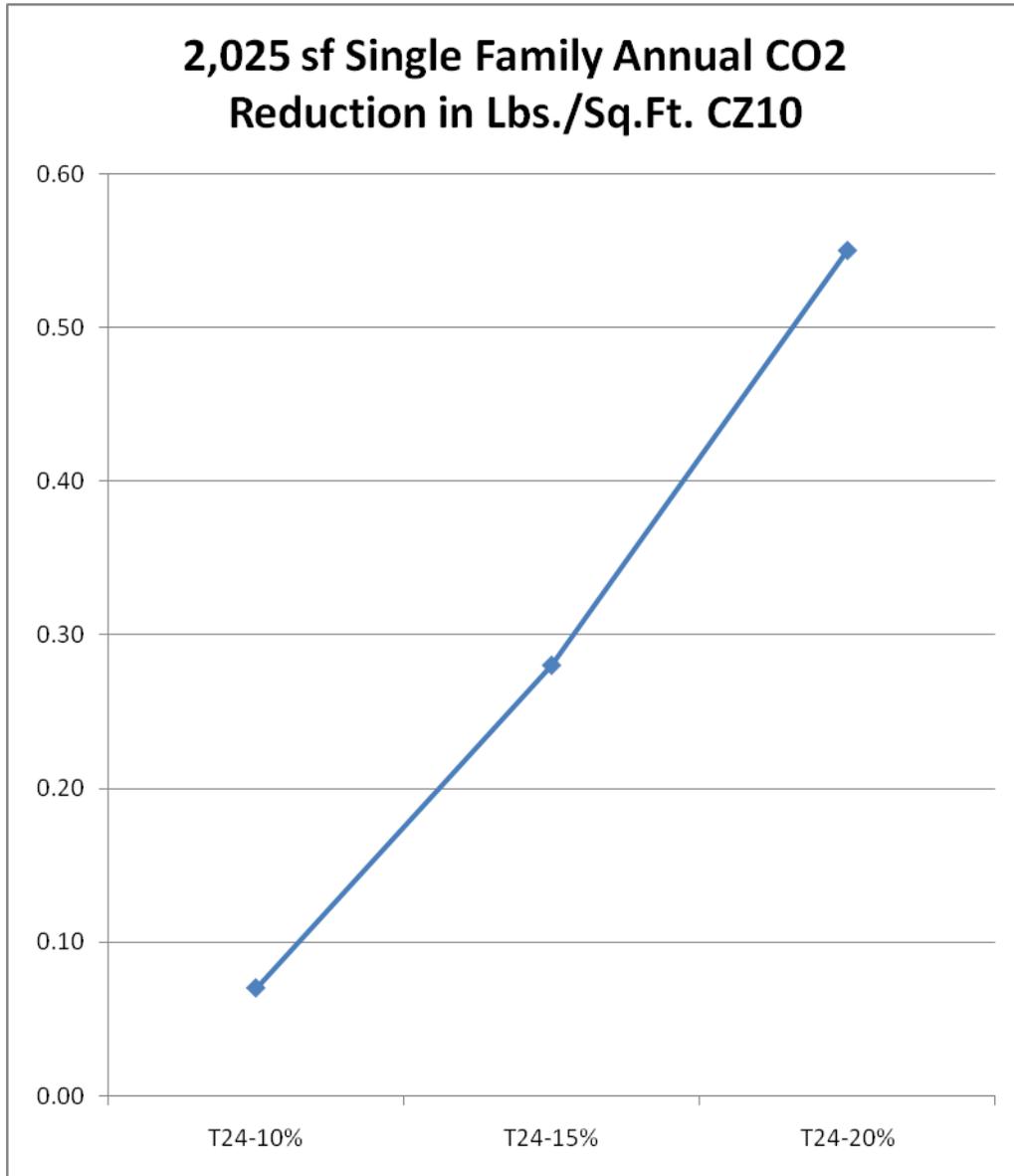
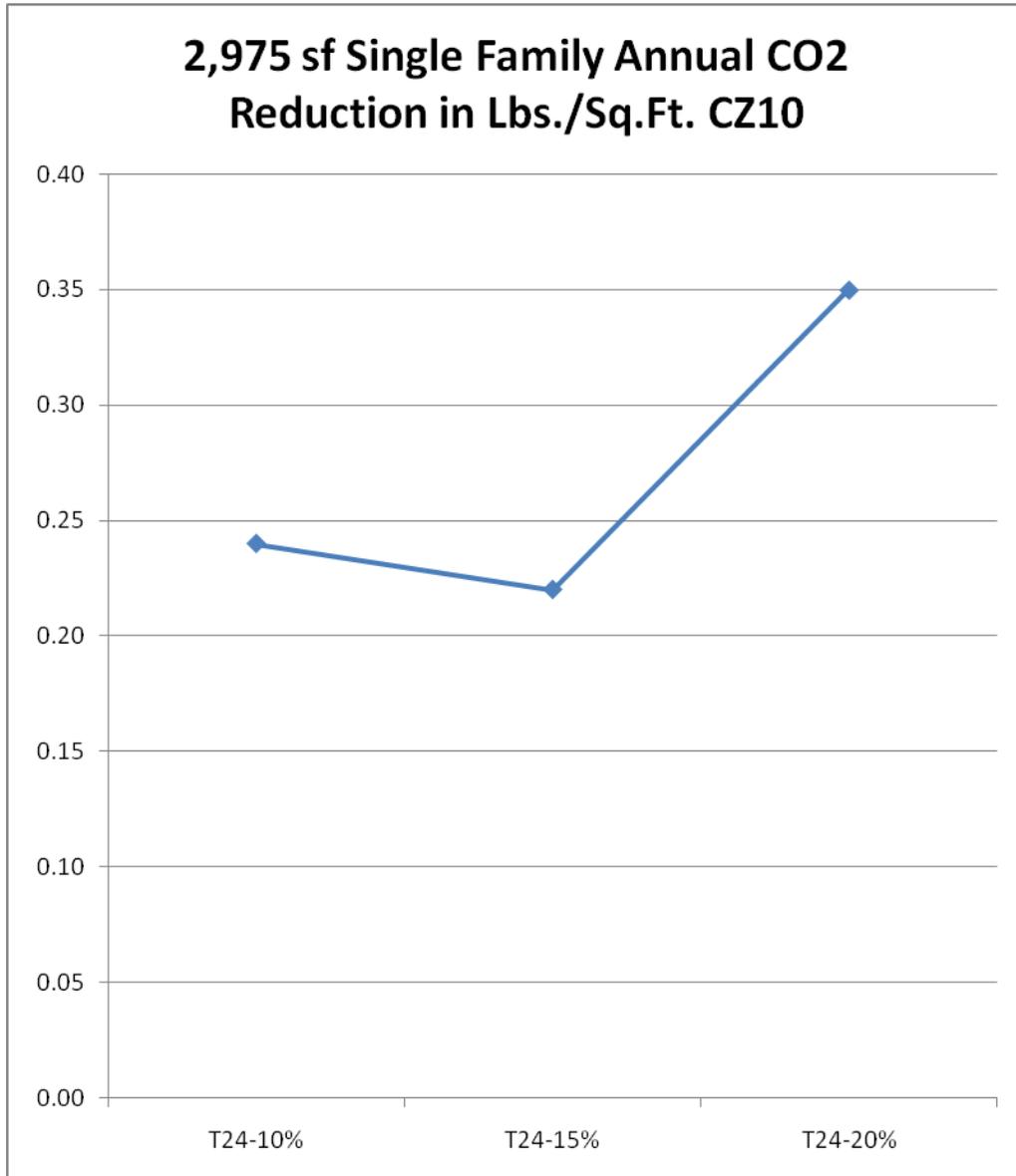
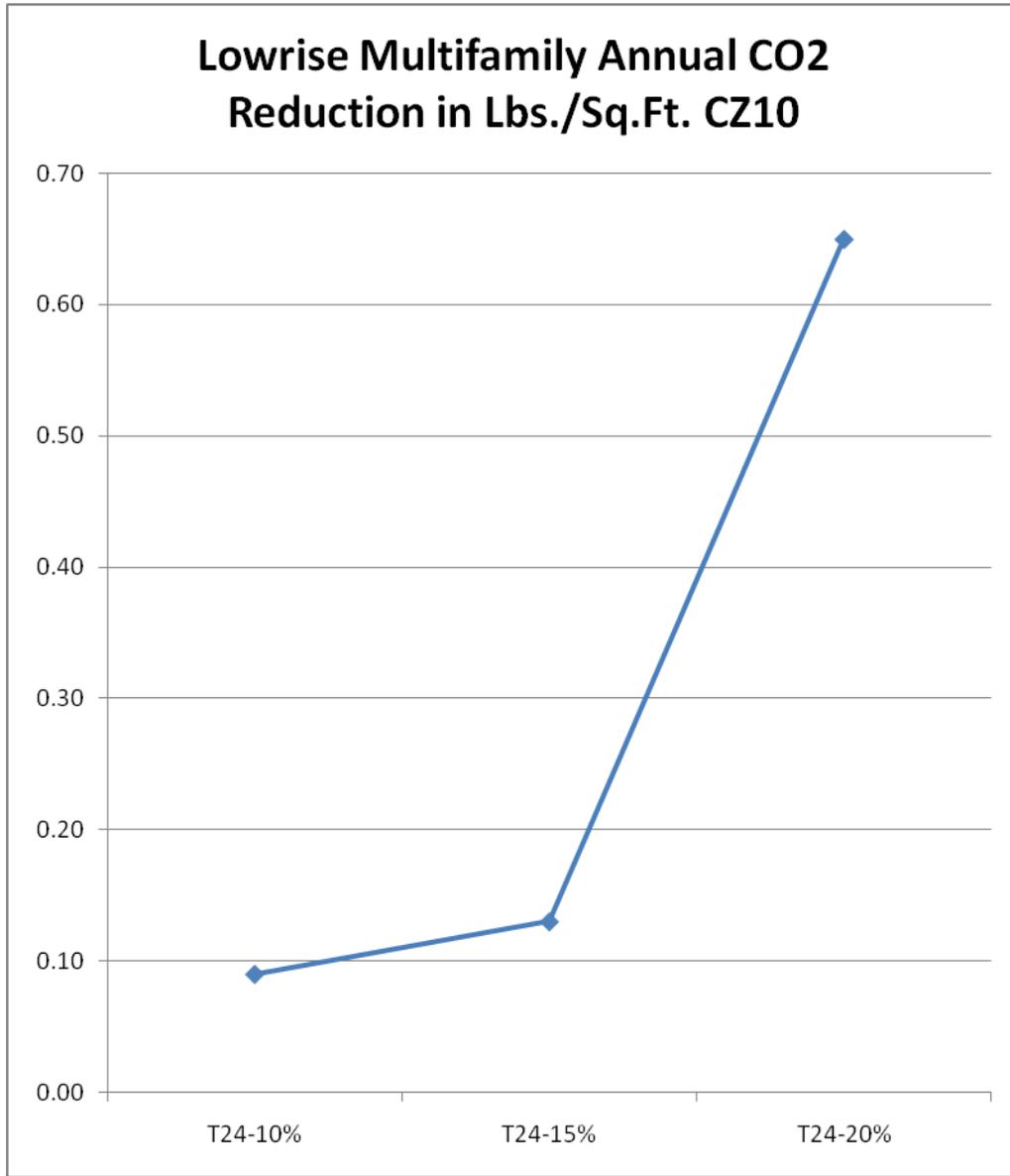


Figure 3-CZ10d-2: Annual Reduction in CO2 in Lbs./Sq.Ft. in Single Family, 2,975 sf 2-Story Single Family Home



**Figure 3-CZ10d-3: Annual Reduction in CO2 in Lbs./Sq.Ft.,
2-Story Multifamily Building**



High-rise Residential Building: Climate Zone 10

10% Better-than-Title 24

The following high-rise residential case study data is based on exceeding the 2008 Title 24 Standards by 10% in Climate Zone 10 as outlined in Section 2.3:

| | |
|---|-------------------------------|
| Average Incremental Cost per Dwelling Unit: | \$ 656 |
| Average Incremental Cost per Square Foot: | \$ 0.71 |
| Simple Payback of Incremental Energy Measures: | 12.8 years |
| Annual Reduction in CO2-equivalent: | 0.12 lbs./sq.ft.- year |

15% Better-than-Title 24

The following high-rise residential case study data is based on exceeding the 2008 Title 24 Standards by 15% in Climate Zone 10 as outlined by Case Study "A" in Section 2.3 (i.e., excluding the expensive solar hot water option in Case Study "B"):

| | |
|---|-------------------------------|
| Average Incremental Cost per Dwelling Unit: | \$1,104 |
| Average Incremental Cost per Square Foot: | \$ 1.94 |
| Simple Payback of Incremental Energy Measures: | 22.4 years |
| Annual Reduction in CO2-equivalent: | 0.42 lbs./sq.ft.- year |

20% Better-than-Title 24

The following high-rise residential case study data is based on exceeding the 2008 Title 24 Standards by 20% in Climate Zone 10 as outlined by Case Study "A" in Section 2.3 (i.e., excluding the expensive solar hot water option in Case Study "B"):

| | |
|---|-------------------------------|
| Average Incremental Cost per Dwelling Unit: | \$1,584 |
| Average Incremental Cost per Square Foot: | \$ 3.10 |
| Simple Payback of Incremental Energy Measures: | 27.2 years |
| Annual Reduction in CO2-equivalent: | 0.62 lbs./sq.ft.- year |

Figure 3-CZ10a-4: Added First Cost/Dwelling Unit, High-rise Residential Building

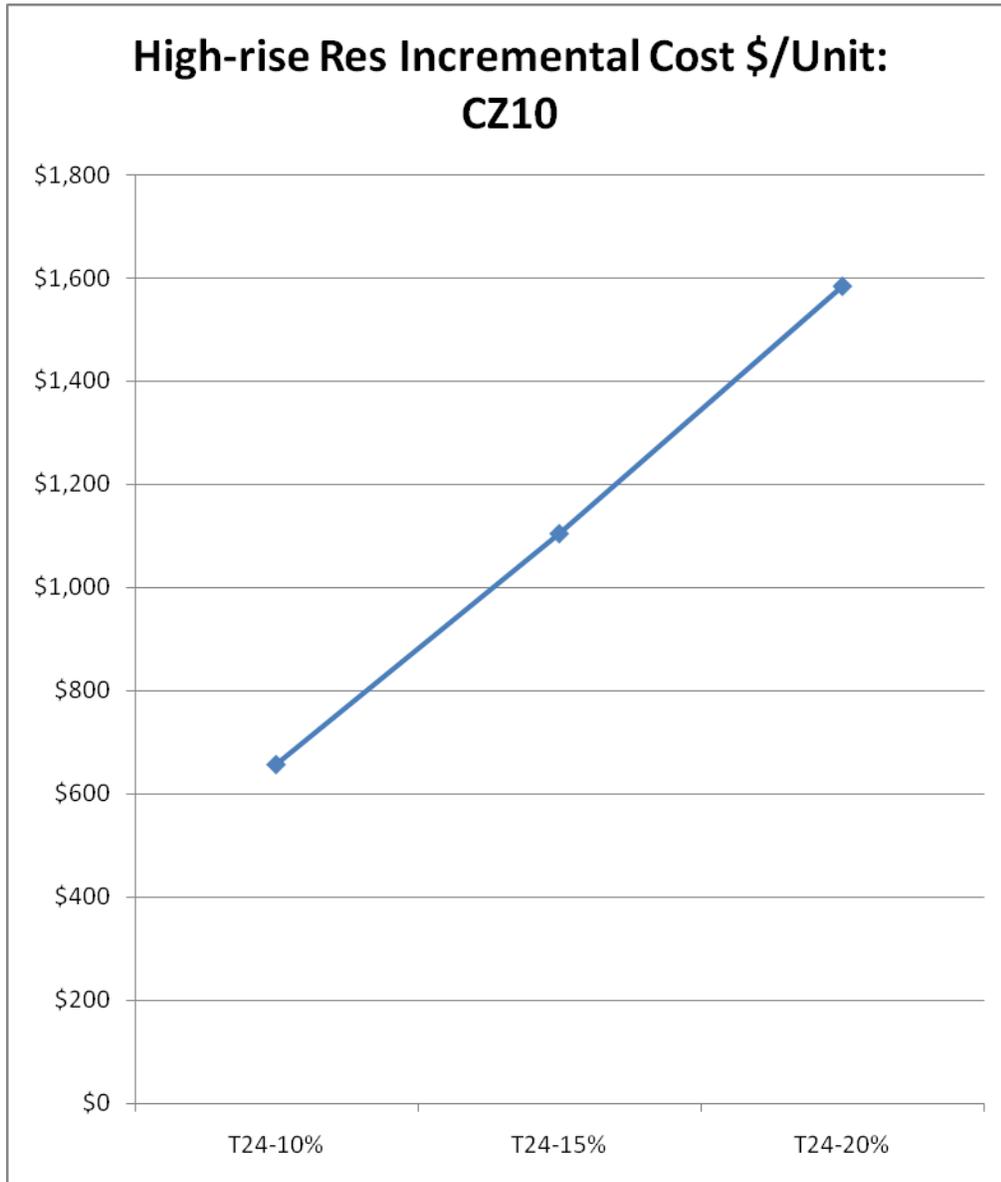


Figure 3-CZ10b-4: Added First Cost/Sq.Ft., High-rise Residential Building

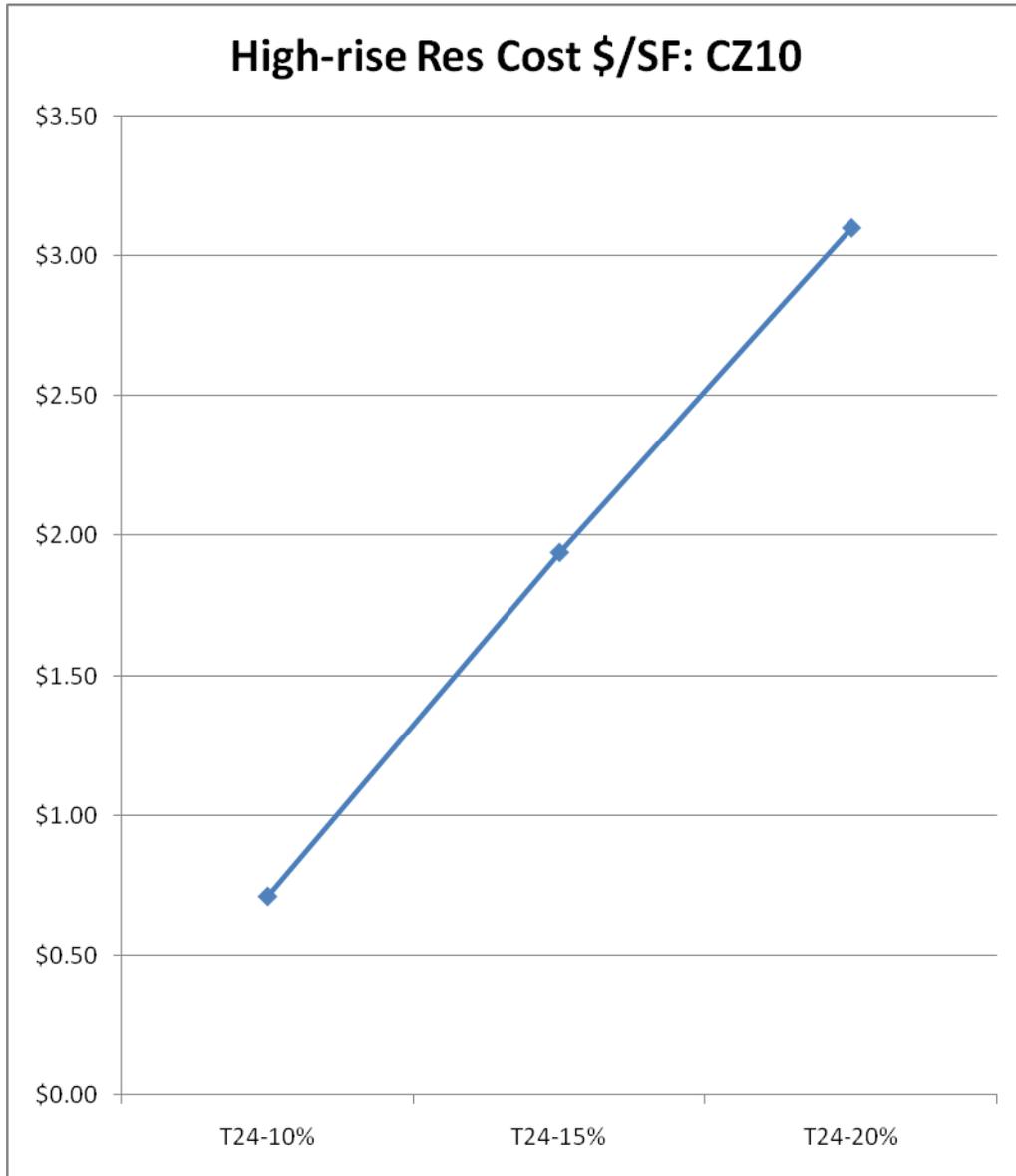


Figure 3-CZ10c-4: Simple Payback of Energy Measures, High-rise Residential Building

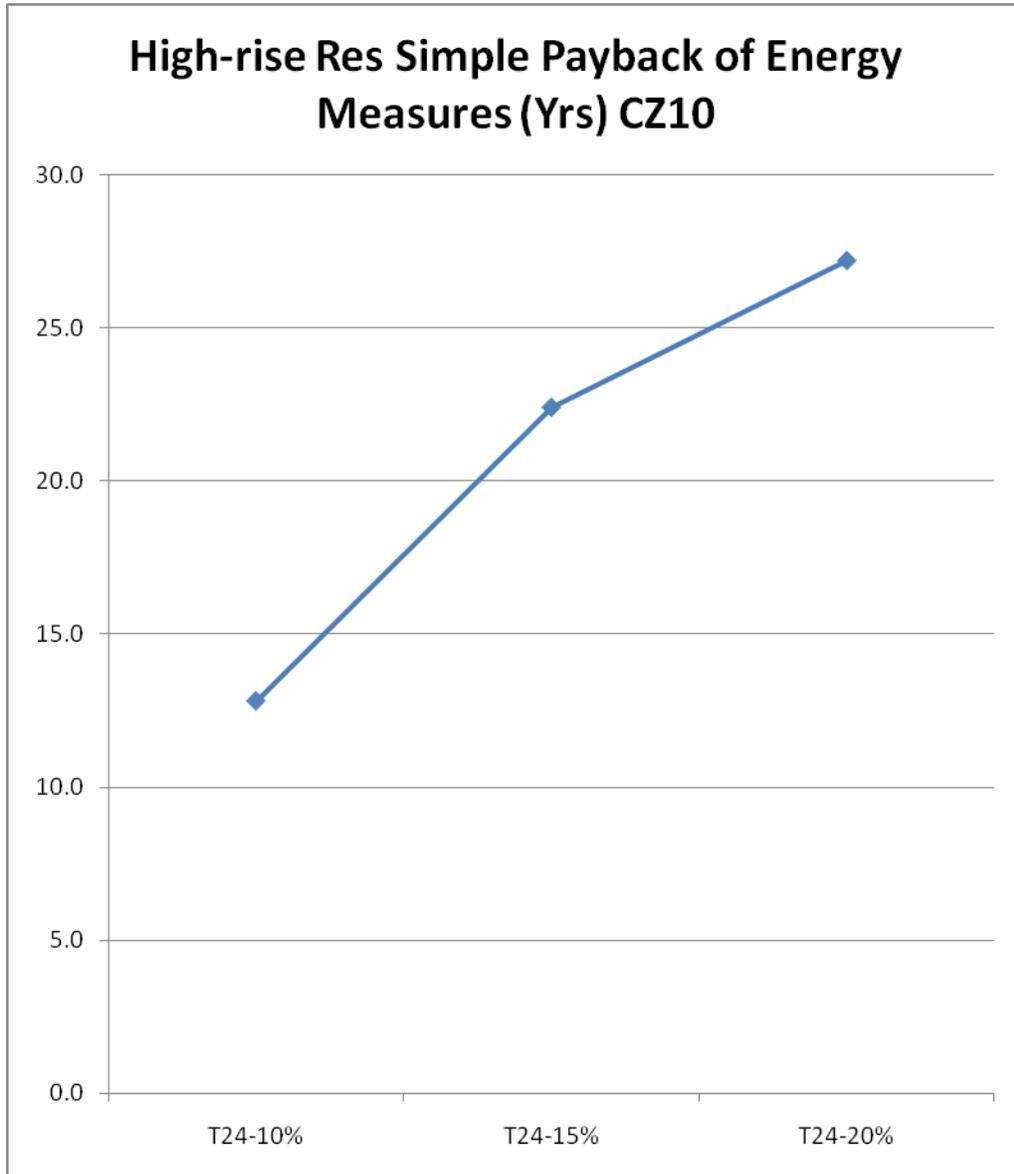
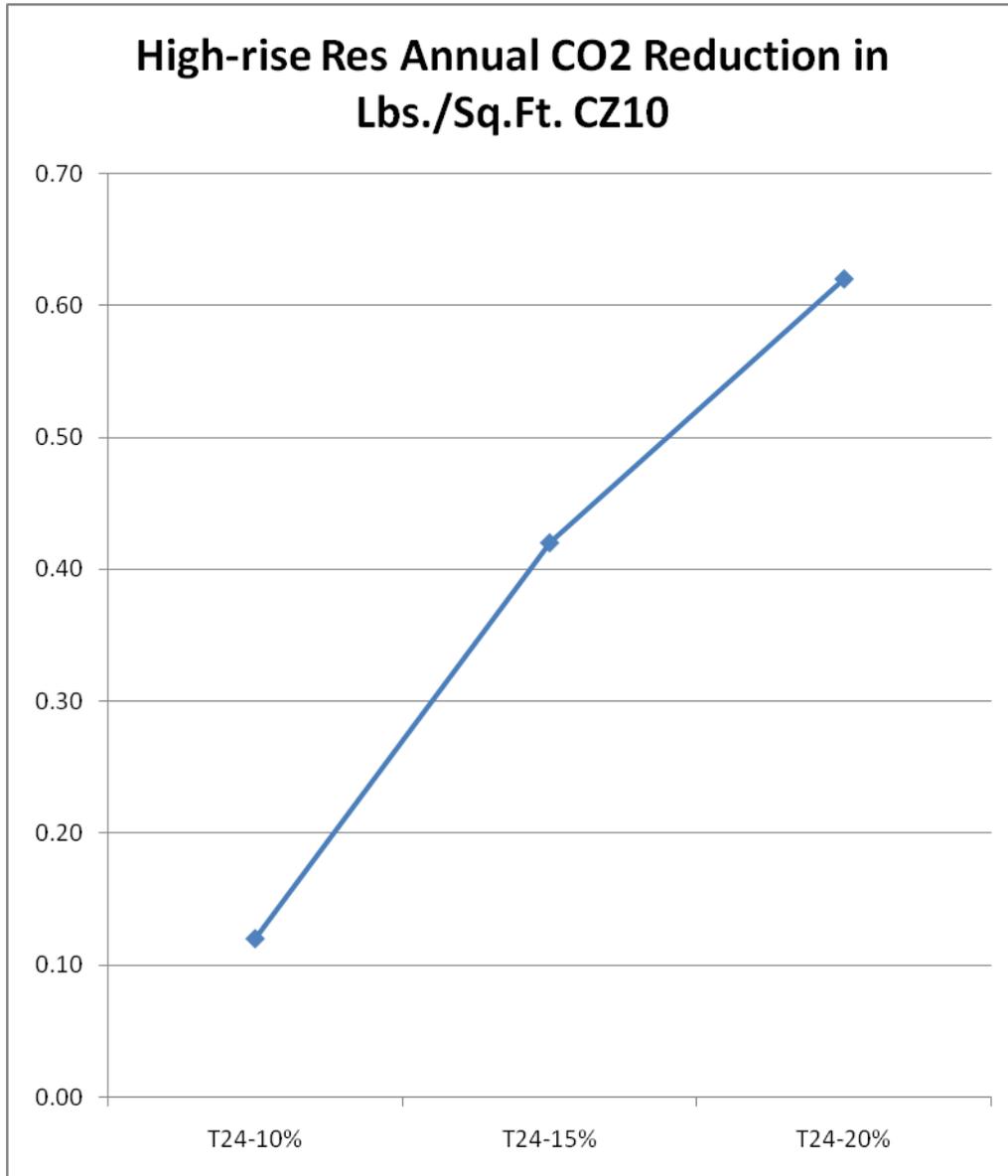


Figure 3-CZ10d-4: Annual Reduction in CO2 in Lbs./Sq.Ft., High-rise Residential Building



Nonresidential Building: Climate Zone 10

10% Better-than-Title 24

The following nonresidential case study data is based on exceeding the 2008 Title 24 Standards by 10% in Climate Zone 10 as outlined in Section 2.4:

| | |
|---|-------------------------------|
| Average Incremental Cost per Building: | \$ 82,884 |
| Average Incremental Cost per Square Foot: | \$ 1.57 |
| Simple Payback of Incremental Energy Measures: | 12.9 years |
| Annual Reduction in CO2-equivalent: | 0.36 lbs./sq.ft.- year |

15% Better-than-Title 24

The following nonresidential case study data is based on exceeding the 2008 Title 24 Standards by 15% in Climate Zone 10 as outlined in Section 2.4:

| | |
|---|-------------------------------|
| Average Incremental Cost per Building: | \$107,769 |
| Average Incremental Cost per Square Foot: | \$ 1.74 |
| Simple Payback of Incremental Energy Measures: | 9.7 years |
| Annual Reduction in CO2-equivalent: | 0.57 lbs./sq.ft.- year |

20% Better-than-Title 24

The following nonresidential case study data is based on exceeding the 2008 Title 24 Standards by 20% in Climate Zone 10 using only one combination of measures as outlined in Section 2.4:

| | |
|---|-------------------------------|
| Incremental Cost per Building: | \$146,098 |
| Incremental Cost per Square Foot: | \$ 2.76 |
| Simple Payback of Incremental Energy Measures: | 10.3 years |
| Annual Reduction in CO2-equivalent: | 0.75 lbs./sq.ft.- year |

Figure 3-CZ10a-5: Added First Cost/Dwelling Unit, Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)



Figure 3-CZ10b-5: Added First Cost/Sq.Ft., Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)



Figure 3-CZ10c-5: Simple Payback of Energy Measures, Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)

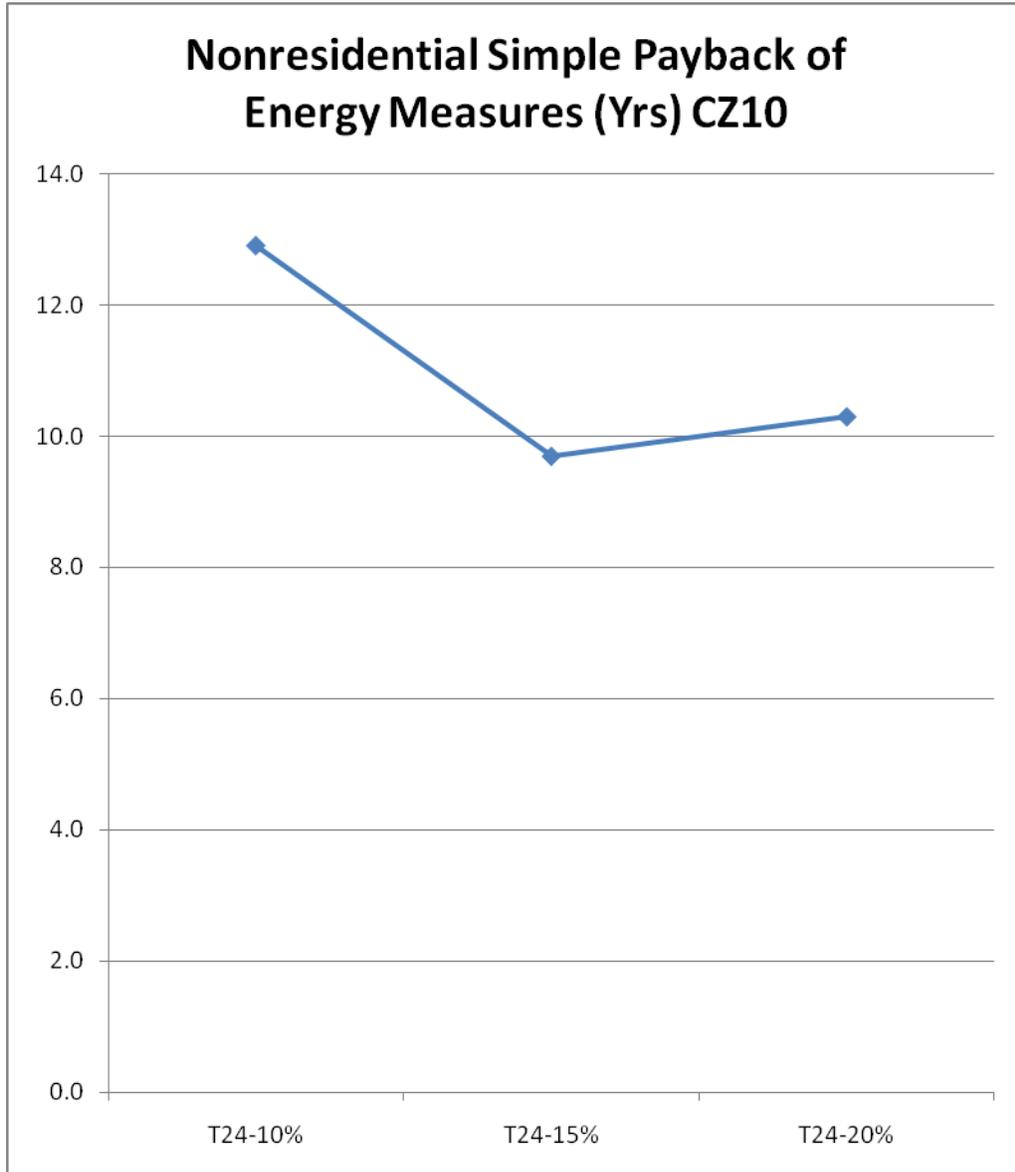
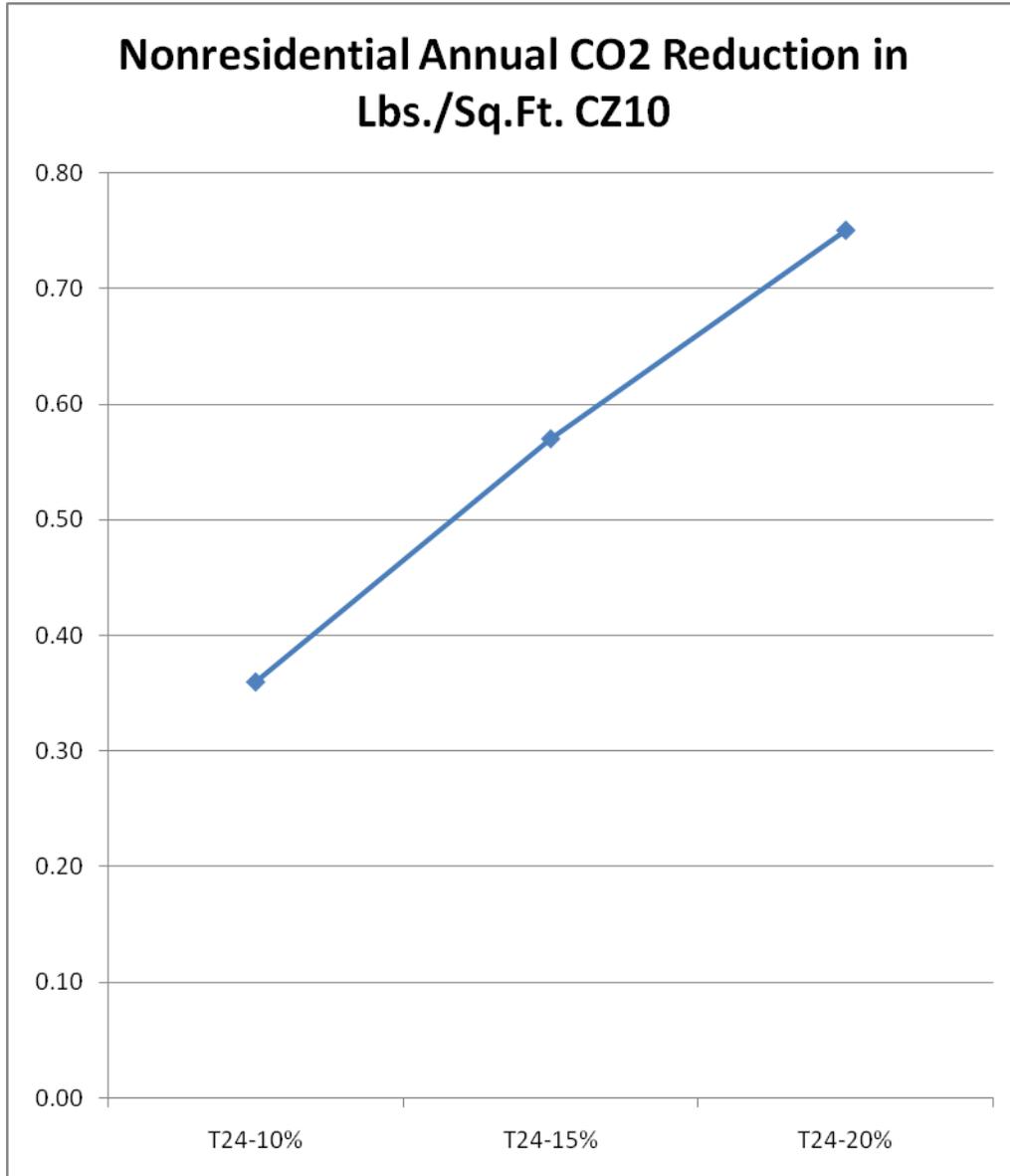


Figure 3-CZ10d-4: Annual Reduction in CO2 in Lbs./Sq.Ft., Nonresidential Building
(Only one combination of energy measures achieves 20% better than Title 24)



4.0 Implementation Plan

The implementation of the City of Chula Vista energy ordinance for low-rise residential buildings is a simple verification that the performance CF-1R form demonstrates that the proposed building exceeds Title 24 standards by at least 15%.

For nonresidential buildings, the PERF-1 is checked to verify that the TDV energy of the proposed building is at least 15% less than the standard design TDV energy. In the %-better-than calculation, process/receptacle energy use components are omitted.

For high-rise buildings, the PERF-1 is checked to verify that the TDV energy of the proposed building is at least 15% less than the standard design TDV energy. In the %-better-than calculation, process/receptacle and lighting energy use components are omitted.

The City of Chula Vista plan review will involve:

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

Field inspection will be identical to working with the 2008 standards.

5.0 Text of the Chula Vista Energy Ordinance

**RECORD OF ACTION TAKEN BY THE CHULA VISTA CITY COUNCIL
ON OCTOBER 20, 2009 INCLUDED ON THE FOLLOWING PAGES.**

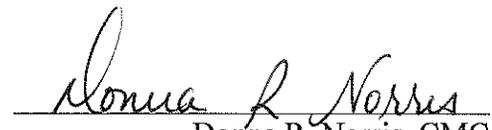


Office of the City Clerk

RECORD OF ACTION TAKEN AT THE REGULAR MEETING OF THE CITY COUNCIL OF THE CITY OF CHULA VISTA ON OCTOBER 20, 2009

The following is the action taken by the Chula Vista City Council at its meeting of October 20, 2009 regarding an Ordinance of the City of Chula Vista related to increased energy efficiency standards.

ACTION: Councilmember Castaneda moved to place the Ordinance of the City of Chula Vista Amending Chapter 15.26 of the Chula Vista Municipal Code and Adding Section 15.26.030, Increased Energy Efficiency Standards, attached hereto as Attachment 1, on first reading, with a referral to staff to analyze potential incentives to induce development through the phasing period. Councilmember Bensoussan seconded the motion, and it carried with the following vote: AYES: Bensoussan, Castaneda, Ramirez, Thompson and Cox; NAYS: None; ABSTENTIONS: None.


Donna R. Norris, CMC
City Clerk
City of Chula Vista

ORDINANCE NO. _____

AN ORDINANCE OF THE CITY OF CHULA VISTA
AMENDING CHAPTER 15.26 OF THE CHULA VISTA
MUNICIPAL CODE AND ADDING SECTION
15.26.030, INCREASED ENERGY EFFICIENCY
STANDARDS

The City Council of the City of Chula Vista does ordain as follows:

SECTION I. Findings. The City Council finds as follows:

1. Modifications to the California Building Standards and Building Energy Efficiency Standards, as detailed in this Ordinance, are reasonably necessary due to local climatic conditions. As a result of high summer ambient temperatures and periods of heat waves, average load demand and peak load demand of energy used in Chula Vista is an important factor concerning public safety and adverse economic impacts of power outages or power reductions. 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.
2. The increased energy efficiency standards required by Section 15.26.030 will require the diminution of energy consumption levels permitted by the 2008 Building Energy Efficiency Standards and are determined to be cost effective based on a cost-effectiveness study by Gabel Associates, LLC.

SECTION II. That Chapter 15.26 of the Chula Vista Municipal Code is hereby amended to read as follows:

Chapter 15.26
ENERGY CODE

Sections:

15.26.010 California Energy Code adopted by reference.

15.26.020 Outdoor lighting zones.

15.26.030 Increased Energy Efficiency Standards

15.26.010 California Energy Code adopted by reference.

The City of Chula Vista adopts, by reference, that certain document known as the California Energy Code, set forth in Title 24, Part 6, of the California Code of Regulations, as copyrighted by, and as may be amended from time to time by, the California Building Standards Commission. That California Energy Code is adopted as the energy code of the City of Chula Vista for the purpose of regulating building design

and construction standards to increase efficiency in the use of energy for new residential and nonresidential buildings, excepting such portions as are modified, or amended by this Chapter to exceed the California Energy Code, set forth in Title 24, Part 6. Chapter 15.06 CVMC shall serve as the administrative, organizational and enforcement rules and regulations for this Chapter.

15.26.020 Outdoor lighting zones.

Pursuant to Section 10-114 (c) of the California Code of Regulations, Title 24, Part 1, the city has adopted an outdoor lighting zones map amending state default lighting zones as applied to certain areas of the City. The location of outdoor lighting zones in the City are per the adopted Outdoor Lighting Zones Map, dated September 2, 2005 and kept on file with the City Planning and Building Department.

15.26.030 Increased Energy Efficiency Standards

- A. Scope. The provisions of this Section shall apply to all new residential construction, additions, remodels and alterations, and to all new non-residential construction, additions, remodels and alterations except as follows:
- a. Additions, remodels or alterations to existing low-rise (three stories or less) residential buildings where the addition, remodel or alteration is less than or equal to 1,000 square feet of conditioned floor area are exempt from the provisions of this Section.
 - b. Additions, remodels or alterations to existing high-rise residential (more than three stories), non-residential or hotel/motel buildings where the addition, remodel or alteration is less than or equal to 10,000 square feet of conditioned floor area are exempt from the provisions of this Section.

Compliance with the California Energy Code is always required even if the increased energy efficiency standards specified in this Section do not apply.

- B. Definitions. Terms used in this Section are as defined in the California Energy Code and Chapter 15.06, 19.06 and 19.48 of the Municipal Code.
- C. Requirements. In addition to the requirements of the California Energy Code, applications for building permits covered under Section 15.26.030 (A) shall comply with the following:
- a. For Climate Zone 7:
 - i. All new low-rise residential buildings or additions, remodels or alterations to existing low-rise residential buildings where the additions, remodels or alterations are greater than 1,000 square feet of conditioned floor area shall use at least 15.0% less TDV Energy than the 2008 Building Energy Efficiency Standards allows.
 - ii. All new non-residential, high-rise residential or hotel/motel buildings, or additions, remodels or alterations to existing non-residential, high-rise residential or hotel/motel buildings where the additions, remodels or alterations are greater than 10,000 square feet of conditioned floor area

shall use at least 15.0% less TDV Energy than the 2008 Building Energy Efficiency Standards allows.

b. For Climate Zone 10:

- i. All new low-rise residential buildings or additions, remodels or alterations to existing low-rise residential buildings where the additions, remodels or alterations are greater than 1,000 square feet of conditioned floor area shall use at least 20.0% less TDV Energy than the 2008 Building Energy Efficiency Standards allows.
- ii. All new non- residential, high-rise residential or hotel/motel buildings, or additions, remodels or alterations to existing non- residential, high-rise residential or hotel/motel buildings where the additions, remodels or alterations are greater than 10,000 square feet of conditioned floor area shall use at least 15.0% less TDV Energy than the 2008 Building Energy Efficiency Standards allows.

D. Compliance. No building permit shall be issued unless the permit application demonstrates compliance with the requirements of Section 15.26.030 based on the performance approach as specified in the 2008 Building Energy Efficiency Standards using a California Energy Commission approved energy compliance software program.

E. Compliance Credit Option for Buildings within Sectional Planning Area (SPA) Plan Projects.

For building construction within Sectional Planning Area (SPA) Plan project areas whose SPA is approved subsequent to the effective date of this Ordinance, the developer may meet a portion of the requirements set forth under Section 15.26.030C provided the SPA Plan has met the qualifying energy savings thresholds for community design and site planning features pursuant to the requirements as set forth in the SPA's approved Air Quality Improvement Plan (AQIP). If the approved AQIP has met the qualifying thresholds, the applicant may request and receive an energy savings credit towards a portion of the requirements specified in Section 15.26.030C subject to approval by the Director of Development Services, provided the project fully complies with the 2008 Building Energy Efficiency Standards (Title 24, Part 6) which are in effect at the time of permitting, and conforms to applicable guidelines in effect at the time of the request for credit.

F. Technical Assistance. The building official may require the applicant to retain the services of a consultant having expertise in energy efficiency techniques to review and evaluate complex systems and/or alternate methods of compliance and provide recommendations as to compliance with the requirements of Section 15.26.030. The cost of such consultant shall be paid by the applicant.

G. Expiration. Section 15.26.030 shall expire upon the date the 2008 Building Energy Efficiency Standards are no longer in effect.

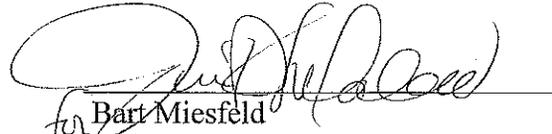
SECTION III. EFFECTIVE DATE.

This ordinance will take effect and be in force thirty days after final passage.

Submitted by:

Approved as to form by

Gary Halbert, AICP, PE
Deputy City Manager/
Director of Development Services



for Bart Miesfeld
City Attorney