

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

Revised October 1, 2008

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1.0 Executive Summary

The City of Palo Alto has researched and reviewed the feasibility and cost-effectiveness of building permit applicants exceeding the 2005 Building Energy Efficiency Standards to meet minimum energy-efficiency requirements of LEED and GreenPoint Rated. On June 2, 2008 the Palo Alto City Council passed Ordinance No. 5006 adopting mandatory green building regulations for residential and commercial building projects, and a companion Resolution No. 8825 establishing specific green building standards to comply with the ordinance. The green building ordinance specifies use of the USGBC LEED rating system for nonresidential buildings and the Build It Green GreenPoint Rated system for residential buildings. Both rating systems specify minimum energy efficiency standards for buildings that exceed the requirements of the current (2005) state standards.

“Adoption of an Ordinance Adding a New Chapter 16.18 to the Palo Alto Municipal Code Establishing Local Energy Efficiency Standards for Certain Buildings and Improvements Covered By the 2005 California Energy Code” was unanimously approved by the Palo Alto City Council on September 8, 2008. The City of Palo Alto would in turn appreciate California Energy Commission approval at the earliest possible date, or no later than the estimated local effective date of December 15, 2008.

Gabel Associates, LLC has been retained to assist in developing this application to the Commission. The proposed local energy efficiency standards and implementation within the green building ordinance have been designed with several key criteria in mind.

- Wherever possible, consistency with the structure, format and calculation methods of the 2005 Title 24 Building Energy Efficiency Standards;
- Meeting local energy compliance requirements as defined by the Ordinance which exceed the current Title 24 standards; and,
- The provision of flexibility for building permit applicants in meeting the Ordinance by the performance approach using building and appliance energy measures.

This application to the California Energy Commission conforms to the requirements laid out in Section 10-106 of the California Code of Regulations, Title 24, Part 1, *LOCALLY ADOPTED ENERGY STANDARDS*. The proposed Ordinance shall take effect only after the Commission has reviewed and formally approved the proposed local energy standards as meeting all requirements of Section 10-106, and the Ordinance has been filed with the Building Standards Commission.

An application to the Commission similar to this one will be submitted well in advance of the effective date of the 2008 standards (July 1, 2009) to demonstrate that the Palo Alto Green Building Ordinance is cost-effective under those standards. This application covers only that period of time when the Ordinance will be in effect while the 2005 standards are also in effect.

Statement per Section 10-106(b)3. The main features of the City's Green Building Ordinance are summarized in Tables A and B below included in Council Resolution No. 8825. The energy ordinance, however, exempts additions and alterations from meeting minimum energy requirements – even though Table A and Table B including those permit scenarios.

- Table A Types of Projects with a minimum energy requirement under the energy ordinance include: New Construction > or = 25,000 sf; New Construction > or = 5,000 sf and < 25,000 sf; and New Construction > or = 500 sf and < 5,000 sf.
- Table B Types of Projects with a minimum energy requirement under the energy ordinance include: New Multifamily Construction of 3 or more attached units; New Single Family Construction > or = 2,550 sf; and New Single Family Construction > or = 1,250 sf and < 2,550 sf.

Table A
City of Palo Alto
Green Building Standards for Compliance
for Private Development
Nonresidential Construction and Renovation

Type of Project ⁵	Building Improvements		
	Checklist Required ²	Minimum Threshold	Verification
Nonresidential Construction and Renovation¹			
New construction \geq 25,000 sf	LEED-NC Checklist	LEED™ Silver (33 points)	LEED/USGBC verification
New construction \geq 5,000 sf and < 25,000 sf	LEED-NC Checklist	LEED™ Silver (33 points)	Threshold verification by LEED™ AP
New construction \geq 500 sf and < 5,000 sf	LEED-NC Checklist	LEED™ Pro-rated points ³	Threshold verification by LEED™ AP
Renovation \geq 5,000 sf and \geq 50% of project sf and \geq \$500,000 ⁶ valuation ³	LEED-NC Checklist	LEED™ Certified (26 points)	Threshold verification by LEED™ AP
Other renovation \geq \$100,000 ⁶ valuation	LEED-CI Checklist	Submit checklist; include on building plans	Self verification
New construction < 500 sf and renovation < \$100,000 ⁶ of valuation	No requirement		
Mixed Use or Other Development	Commercial and residential criteria as applicable ⁴		

¹ Cumulative new construction or renovations over any 2-year period following adoption of these requirements shall be considered as a single project, unless exempted by the Planning Director as impractical for compliance.

² Compliance with other LEED™ checklists, including but not limited to LEED-CS (Core & Shell), LEED-CI (Commercial Interiors), or LEED-EB (Existing Buildings) may be substituted for the designated rating system where deemed appropriate by the Planning Director, after recommendation by the Architectural Review Board (if ARB is required)

³ Pro-rated formula = (new construction sf/5,000) x 33 points, but not less than 17 points.

⁴ To be determined by the Planning Director; generally the provisions of Table A will apply to the commercial portion of the development, and the provisions of Table B will apply to the residential portions of the development.

⁵ Exemptions may be available for historic structures, pursuant to Section 18.44.070 of the ordinance. The Compliance Official may allow the use of alternative checklists for historic buildings or for buildings that retain or re-use substantial portions of the existing structure.

⁶ To be adjusted annually to reflect changes to the City's valuation per square foot of new construction.

Table B
City of Palo Alto
Green Building Standards for Compliance for Private Development
Residential Construction and Renovation

Type of Project ⁴	Building Improvements		
	Checklist Required	Minimum Threshold	Verification
Multi-Family Residential¹			
New construction of 3 or more (attached) units ²	Multifamily GreenPoint Checklist	70 points ⁴	GreenPoint Rated verification
Additions and/or renovations with permit valuation \geq \$100,000 ⁵	Multifamily GreenPoint Checklist	Submit checklist; include on building plans	Self verification
Additions and/or renovations with permit valuation $<$ \$100,000 ⁵	No requirement		
Single-Family and Two-Family Residential¹			
New construction of \geq 2,550 sf	Single-Family GreenPoint Checklist	70 points + 1 point per additional 70 sf (150 points maximum) ⁴	GreenPoint Rated verification
New construction of \geq 1,250 sf and $<$ 2,550 sf	Single-Family GreenPoint Checklist	70 points ⁴	GreenPoint Rated verification
Additions ($<$ 1,250 sf) and/or renovations with permit valuation \geq \$350,000 ⁵	Single-Family GreenPoint Checklist	70 points ⁴	GreenPoint Rated verification
Additions ($<$ 1,250 sf) and/or renovations \geq \$75,000 ⁵ and $<$ \$350,000 ⁵ permit valuation	Home Remodeling Green Building Checklist	Submit checklist; include on building plans	Self verification
Additions and/or renovations of $<$ \$75,000 ⁵ permit valuation	No requirement		
Mixed Use or Other Development	Commercial and residential criteria as applicable ³		

¹ Cumulative new construction or renovations over any 2-year period following adoption of these requirements shall be considered as a single project, unless exempted by the Planning Director as impractical for compliance.

² For any multi-family residential project with 30 or more new units proposed, a LEED-ND (Neighborhood Development) checklist shall also be completed and submitted with the application, for information only.

³ To be determined by the Planning Director; generally the provisions of Table A will apply to the commercial portion of the development, and the provisions of Table B will apply to the residential portions of the development.

⁴ Exemptions may be available for historic structures, pursuant to Section 18.44.070. The Compliance Official may allow the use of alternative checklists for historic buildings or for buildings that retain or re-use substantial portions of the existing structure, and may reduce the minimum threshold (points) required as outlined in Section 18.44.050.

⁵ To be adjusted annually to reflect changes to the City's valuation per square foot of new construction.

2.0 Impacts of the New Ordinance

The energy performance impacts of the Ordinance have been evaluated using case studies which reflect the broad range of building types covered.

- Single family house: 1,775 sq.ft., 2-story
- Single family house: 2,682 sq.ft., 2-story
- 8-unit multi-family: 8,442 sq.ft., 2-story
- 30-unit, high-rise multi-family residential building: 27,600 sq.ft., 4-story
- Nonresidential building: 42,320 sq.ft., 4-story

2.1 Single Family Houses

The following methodology and assumptions are used in evaluating the impact of the Ordinance on single family homes.

House Designs. Two house plans have been modeled to just meet Title 24. Then, in each case, they've been redesigned in two different ways to determine the cost-effectiveness of the proposed Ordinance which requires that low-rise residential buildings exceed Title 24 by a minimum of 15%. The additional (i.e., incremental) energy measures have been evaluated to determine a payback period which includes their cumulative first cost and annual energy cost saving as explained in a later section.

1,775 SF 2-story home as designed, **22.0% total fenestration** area:

- R-38 attic roof w/ radiant barrier; some R-30 vaulted roof with no radiant barrier
- R-13 exterior walls
- 31% of house footprint R-19 raised floor
- 69% of house footprint covered slab floor
- Dual vinyl windows, U=0.51, SHGC=0.48 w/ one overhang
- Furnace: 90% AFUE
- Air conditioner: 13.0 SEER (minimum efficiency), 11.0 EER
- R-6 ducts in the attic
- DHW: 50 gallon gas water heater, EF=0.62; no extra pipe insulation

2,682 SF 2-story home as designed, **22.3% total fenestration** area:

- R-38 roof w/ radiant barrier
- R-13 exterior walls
- Covered slab-on-grade floor
- Dual vinyl windows, U=0.51, SHGC=0.48 w/ several overhangs
- Furnace: 80% AFUE
- No Cooling
- R-6 ducts in the attic
- DHW: 50 gallon gas water heater, EF=0.60; no extra pipe insulation

Energy Measures Needed to Meet the City's Ordinance

The following energy features have been modified from the above Title 24 set of measures so that the single family houses use 15% less TDV energy than the corresponding Title 24 base case design, (A) or (B). The incremental first cost to provide that measure in comparison with the equivalent base case measure is listed to the right.

The incremental energy improvements specified above to meet the proposed Ordinance requirements are variables typically selected by designer, builder or owner. There are a number of considerations in choosing the final mix of energy measures including first cost, amenities, aesthetics, maintenance and replacement costs. The incremental first cost to provide that measure in comparison with the equivalent base case measure is listed to the right.

(A) 1,775 sq.ft.

• Vinyl Low-E windows: U-factor=0.31, SHGC=0.36 312 sf @ \$1.30 - \$1.50/sf	\$ 406 - 468
• TXV/EER verification [HERS]: total incremental cost	\$ 100 - 150
• R-8 duct insulation (from R-6.0)	\$ 250 - 300
• R-30 raised floor (from R-19), 263 sf: \$0.18 - 0.24/sf	\$ 47 - 63
Total incremental cost of Ordinance energy measure:	\$ 803 - 981
Incremental cost in \$/sq.ft.:	\$ 0.45 to 0.55 /sq.ft.

(B) 1,775 sq.ft.

• Vinyl Low-E windows: U-factor=0.31, SHGC=0.36 312 sf @ \$1.30 - \$1.50/sf	\$ 406 - 468
• TXV/EER verification [HERS]: total incremental cost	\$ 100 - 150
• 14.0 SEER / 11.0 EER air conditioner	\$ 400 - 500
Total incremental cost of Ordinance energy measure:	\$ 906 - 1,118
Incremental cost in \$/sq.ft.:	\$ 0.51 to 0.63 /sq.ft.

(A) 2,682 sq.ft.

• Vinyl Low-E windows: U-factor=0.31, SHGC=0.36 597 sf @ \$1.30 - \$1.50/sf	\$ 776 - 896
• Hot water pipe insulation to kitchen	\$ 100 - 150
Total incremental cost of Ordinance energy measure:	\$ 876 - 1,046
Incremental cost in \$/sq.ft.:	\$ 0.33 to 0.39 /sq.ft.

(B) 2,682 sq.ft.

• Reduced duct leakage [HERS]: total incremental cost:	\$ 450 - 600
• 0.80 EF water heater: incremental cost	\$ 900 - 1,100
• Hot water pipe insulation to kitchen	\$ 100 - 150
Total incremental cost of Ordinance energy measure:	\$ 1,450 - 1,850
Incremental cost in \$/sq.ft.:	\$ 0.54 to 0.69/sq.ft.

2.2 Low-rise Multi-family 2-Story Residential Building

The following methodology and assumptions are used in evaluating the impact of the Ordinance on a two-story multi-family building.

Two different sets of Title 24 energy measures are used as the base case for comparison with sets of energy measures developed to just meet the minimum energy requirements of the proposed ordinance which requires that low-rise residential buildings exceed the 2005 Title 24 standards by 15%. The incremental energy measures are evaluated to determine a payback period including cumulative first cost and cumulative annual energy cost saving as explained in that section.

(A) 8,442 SF, 8-Unit, 2-story building, no cooling, 12.5% total fenestration area:

- R-30 roof with radiant barrier
- R-13 exterior walls
- Covered slab-on-grade floor
- Vinyl Low-E windows: U=0.39, SHGC=0.33, no overhangs
- Furnaces: 80% AFUE / No Cooling
- R-6 ducts in the attic
- DHW: 30 gallon gas water heaters, EF=0.60, no extra pipe insulation

(B) 8,442 SF, 8-Unit, 2-story building, w/ cooling, 12.5% total fenestration area:

- R-38 roof with radiant barrier
- R-13 exterior walls
- Covered slab-on-grade floor
- Vinyl Low-E windows: U=0.39, SHGC=0.33, no overhangs
- Split Heat Pumps: HSPF=8.0, SEER=14.2 / EER=11.8
- R-6 ducts in the attic
- DHW: 30 gallon gas water heaters, EF=0.60, no extra pipe insulation

Energy Measures Needed to Meet the City's Ordinance.

The following energy features have been modified from the above Title 24 set of measures so that the multi-family building uses 15% less TDV energy than the corresponding Title 24 base case design, (A) or (B). The incremental first cost to provide that measure in comparison with the equivalent base case measure is listed to the right.

The incremental energy improvements specified above to meet the proposed Ordinance requirements are variables typically selected by designer, builder or owner. There are a number of considerations in choosing the final mix of energy measures including first cost, amenities, aesthetics, maintenance and replacement costs. The incremental first cost to provide that measure in comparison with the equivalent base case measure is listed to the right.

(A) 8,442 sq.ft.

• Reduced Duct Leakage & testing [HERS] for 8 units: (incremental cost includes installation & sampling)	\$ 2,400 - 3,000
• Tankless gas water heaters, EF=0.81	\$ 6,400 - 8,000
• <u>92% AFUE furnaces</u>	<u>\$ 3,600 - 5,600</u>
Total incremental cost of Ordinance energy measure:	\$ 12,400 - 16,600
Incremental cost in \$/sq.ft.:	\$ 1.47 to 1.97 /sq.ft.

(B) 8,442 sq.ft.

• Reduced Duct Leakage & testing [HERS] for 8 units: (incremental cost includes installation & sampling)	\$ 2,400 - 3,000
• Vinyl Super Low-E windows: U-factor=0.30, SHGC=0.28 1,054 sf @ \$1.30 - \$1.50/sf	\$ 1,370 - 1,580
• Tankless gas water heaters, EF=0.81	\$ 6,400 - 8,000
• <u>All ¾" dia. hot water pipes insulated to R-4.2</u>	<u>\$ 2,000 - 2,800</u>
Total incremental cost of Ordinance energy measure:	\$ 12,170 - 15,380
Incremental cost in \$/sq.ft.:	\$ 0.51 to 0.63 /sq.ft.

2.3 High-Rise 4-Story Residential Building

The following methodology and assumptions are used in evaluating the impact of the Ordinance on a four-story multi-family building.

30 Unit Apartment Building. A four-story building, with the top three floors containing 30 apartments (over a retail space) with a total residential conditioned floor area of 27,600 square foot has been modeled in two ways to determine the cost-effectiveness of the proposed Palo Alto Ordinance. The total glazing area for this building is a Window Wall Ratio (WWR) of 35.2%, typical of this occupancy type.

One set of Title 24 energy measures are used as the base case for comparison with two sets of energy measures developed to just meet the minimum energy requirements of the proposed ordinance which requires that high-rise residential buildings exceed the 2005 Title 24 standards by 15%. The incremental energy measures are evaluated to determine a payback period including cumulative first cost and cumulative annual energy cost saving as explained in that section.

(A) 27,600 SF 4-story apartment building which just meet Title 24:

- R-30 attic roof (no cool roof or radiant barrier)
- R-19 in metal frame exterior walls
- Dual vinyl NFRC-rated windows: U-factor=0.42, SHGC=0.39, w/ no exterior shading
- 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

Energy Measures Needed to Meet the City’s Ordinance.

Incremental energy measures to meet the Ordinance have been evaluated for the above 4-story apartment building. The following energy features have been modified from the Title 24 measures so that these buildings use at least 15% less TDV energy than the corresponding base case design, (A) or (B). The incremental first cost to provide that measure in comparison with the equivalent base case measure is listed to the right.

(A) 27,600 sq.ft.

- Vinyl Super Low-E2 windows: U-factor=0.33, SHGC=0.23
4,680 sf @ \$2.50 - \$3.50/sf \$ 11,700 - 16,380
- Total incremental cost of Ordinance energy measure: \$ 11,700 - 16,380**
- Incremental cost in \$/sq.ft.: \$ 0.42 to 0.59 /sq.ft.**

(B) 27,600 sq.ft.

- Vinyl Super Low-E2 windows: U-factor=0.33, SHGC=0.23 \$ 11,700 - 16,380
4,680 sf @ \$2.50 - \$3.50/sf
- Better Room Heat Pumps, 7.84 HSPF, 11.2 EER \$ 12,000 - 15,000
- Total incremental cost of Ordinance energy measure: \$ 23,700 - 31,380**
- Incremental cost in \$/sq.ft.: \$ 0.86 to 1.14 /sq.ft.**

2.4 Nonresidential 4-Story Office Building

The following methodology and assumptions are used in evaluating the impact of the Ordinance on a five-story nonresidential building.

4-Story Office Building. A four-story office building with a total conditioned floor area of 42,320 square foot has been modeled in two ways to determine the cost-effectiveness of the proposed Ordinance. The total glazing area for this building is a Window Wall Ratio (WWR) of 32.7%, typical of this occupancy type.

Two different sets of Title 24 energy measures are used as the base case for comparison with sets of energy measures developed to just meet the minimum energy requirements of the proposed ordinance which requires that nonresidential buildings meet minimum LEED requirements which the City has equated with exceeding the 2005 Title 24 standards by 15%. The incremental energy measures are evaluated to determine a payback period including cumulative first cost and cumulative annual energy cost saving as explained in that section.

42,320 SF 4-story office building

- R-30 attic roof (no cool roof or radiant barrier)
- R-19 in metal frame exterior walls
- Un-insulated (R-0) 1st floor slab-on-grade
- Dual metal NFRC-rated Low-E windows: U-factor=0.50, SHGC=0.54, w/ no exterior shading
- 25-ton package VAV units, gas heating/electric cooling, 80.0% AFUE, 10.4 EER, one air handling/floor, VAV boxes w/ 30% minimum airflow and hot water reheat
- Central service hot water boiler, 82% AFUE
- Installed lighting power density is 1.161 watts/sq.ft.; Allowed LPD=1.10 watts/sq.ft.
- 630 2-lamp 4' T8 fixtures, default 62 input watts/fixture (87% of total installed watts)
- 224 26w compact fluorescent fixtures (13% of total installed watts)
- No lighting controls

Energy Measures Needed to Meet the City's Ordinance.

Incremental energy measures to meet the Ordinance have been evaluated for the above 4-story office building. The following energy features have been modified from the Title 24 measures so that these buildings use at least 15% less TDV energy than the corresponding base case design, (A) or (B). The incremental first cost to provide that measure in comparison with the equivalent base case measure is listed to the right.

(A) 42,320 sq.ft.

- 630 2-lamp 4' T8 fixtures with high efficiency instant start \$ 15,750 - 18,900 ballasts and premium T8 lamps, 55 input watts @\$25.00 - \$30.00/fixture; Installed LPD=0.872 (w/ occ. sensors)
 - 132 occupant sensors controlling 2-lamp T8 fixtures. \$ 8,580 - 11,220 @\$65.00 - \$85.00 each
 - Metal NFRC-rated windows: U-factor=0.50, SHGCc=0.34 \$ 11,300 - 18,840 for upper floors, SHGCc=0.38 for 1st floor retail 7,536 sf @\$1.50 - 2.50/sq.ft.
-
- Total incremental cost of Ordinance energy measure: \$ 35,630 - 48,960**
Incremental cost in \$/sq.ft.: \$0.84 to 1.16 /sq.ft.

(B) 42,320 sq.ft.

- 630 2-lamp 4' T8 fixtures with high efficiency instant start \$ 15,750 - 18,900 ballasts and premium T8 lamps, 55 input watts @\$25.00 - \$30.00/fixture; Installed LPD=0.872 (w/ occ. sensors)
 - 154 occupant sensors controlling 2-lamp T8 fixtures. \$ 10,010 - 13,090 @\$65.00 - \$85.00 each
 - Reduction in input watts for the same recessed CFLs \$ 0 - 0
 - Metal NFRC-rated windows: U-factor=0.50, SHGCc=0.34 \$ 11,300 - 18,840 for all floors: 7,536 sf @\$1.50 - 2.50/sq.ft.
-
- Total incremental cost of Ordinance energy measure: \$ 37,060 - 50,830**
Incremental cost in \$/sq.ft.: \$0.88 to 1.20 /sq.ft.

3.0 Cost Effectiveness

Tables 3-1a through 3-5a in this section, “*Summary of Energy Savings from Palo Alto Energy Measures*”, are based upon:

- Incremental site electricity (kWh) and natural gas (therms) saved per year as calculated using the state-approved energy compliance software for the 2005 Building Energy Efficiency Standards, EnergyPro Version 4.4
- Average utility rates of \$0.12/kWh for electricity and \$1.60/therm for natural gas in current constant dollars
- The assumption of no change (i.e., no inflation or deflation) of utility rates in constant dollars over time
- The assumption of no increase in summer temperatures, even though recent scientific studies suggest that global climate change will increase temperatures in the Western U.S. which in turn will increase air conditioning energy use

Tables 3-1b through 3-5b, “*Summary of Simple Payback for Palo Alto Energy Measures*”, include a cost-effectiveness analysis of the Ordinance with respect to each building occupancy type and design; and assumes:

- No external cost of global climate change -- and corresponding value of additional investment in energy efficiency and CO₂ reduction – is included
- The cost of money invested in the incremental cost of energy measures is not included.

3.1 Single Family House

The cost effectiveness of meeting the requirements of the Ordinance is calculated for the home designs analyzed two different ways as explained above. This reflects the different ways that architects, builders and home owners might choose to meet the basic Title 24 requirements depending on preferences. The total incremental first cost needed to meet the Ordinance is divided by the incremental annual energy cost saving to establish the Simple Payback for the additional energy features.

Table 3-1a: Summary of Energy Savings from Palo Alto Energy Measures

Building Description	Site Electricity Savings (KWh/yr)	Site Gas Savings (therms/yr)	Electricity Cost Savings (\$)	Nat. Gas Cost Savings (\$)	Total Annual Cost Savings (\$)
1,775 sf (A)	262	34	\$28	\$44	\$72
1,775 sf (B)	283	28	\$30	\$36	\$66
2,682 sf (A)	243	61	\$26	\$79	\$105
2,682 sf (B)	35	120	\$4	\$156	\$160

Table 3-1b: Summary of Simple Payback for Palo Alto Energy Measures

Building Description	Total Incremental First Cost (\$) ¹	Incremental Annual Energy Cost Savings (\$)	Simple Payback (years)
1,775 sf (A)	\$892	\$72	12.4
1,775 sf (B)	\$1,012	\$66	15.3
2,682 sf (A)	\$961	\$105	9.2
2,682 sf (B)	\$1,650	\$160	10.3

Note 1: The average incremental first cost, Section 2.1, as compared with the Title 24 base case design.

Based on this case study, the Ordinance increases the cost of this type of construction by approximately \$0.35 to \$0.70 per square foot. If the overall total cost of new construction is in the range of \$400 to \$500 per square foot, for example, the Ordinance will increase the cost by approximately one- to two-tenths of one percent (0.1% to 0.2%).

3.2 Low-rise Multi-Family Residential Buildings

Table 3-2a: Summary of Energy Savings from Palo Alto Energy Measures

Building Description	Site Electricity Savings (KWh/yr)	Site Natural Gas Savings (therms/yr)	Electricity Cost Savings (\$)	Natural Gas Cost Savings (\$)	Total Annual Cost Savings (\$)
8,442 sf (A)	86	515	\$9	\$670	\$679
8,442 sf (B)	2595	236	\$272	\$307	\$579

Table 3-2b: Summary of Simple Payback for Palo Alto Energy Measures

Building Description	Total Incremental First Cost (\$)	Incremental Annual Energy Cost Savings (\$)	Simple Payback (years)
8,442 sf (A)	\$14,500	\$679	21.4
8,442 sf (B)	\$13,775	\$579	23.8

Note 1: The average incremental first cost, Section 2.2, as compared with the Title 24 base case design.

Based on this case study, the Ordinance increases the cost of this type of construction by approximately \$0.50 to \$2.00 per square foot, or approximately three- to five-tenths of one percent (0.1% to 0.4%).

3.3 High-rise (4-Story) Multi-Family Building

Table 3-3a: Summary of Energy Savings from Palo Alto Energy Measures

Building Description	Site Electricity Savings (KWh/yr)	Site Natural Gas Savings (therms/yr)	Electricity Cost Savings (\$)	Natural Gas Cost Savings (\$)	Total Annual Cost Savings (\$)
27,600 sf (A)	12695	50	\$1,333	\$65	\$1,398
27,600 sf (B)	9837	50	\$1,033	\$65	\$1,098

Table 3-3b: Summary of Simple Payback for Palo Alto Energy Measures

Building Description	Total Incremental First Cost (\$)	Incremental Annual Energy Cost Savings (\$)	Simple Payback (years)
27,600 sf (A)	\$14,040	\$1,398	10.0
27,600 sf (B)	\$27,540	\$1,098	25.1

Note 1: The average incremental first cost, Section 2.3, as compared with the Title 24 base case design.

Based on this data, the Ordinance increases the cost of this type of construction by approximately \$0.40 to \$1.15 per square foot, or approximately one-tenth to three-tenths of one percent (0.1% to 0.3%).

3.4 Nonresidential 4-Story Office Building

Table 3-4a: Summary of Energy Savings from Palo Alto Energy Measures

Building Description	Site Electricity Savings (KWh/yr)	Site Natural Gas Savings (therms/yr)	Electricity Cost Savings (\$)	Natural Gas Cost Savings (\$)	Total Annual Cost Savings (\$)
42,320 sf (A)	53961	-293	\$6,475	-\$440	\$6,036
42,320 sf (B)	52388	-88	\$6,287	-\$132	\$6,155

Table 3-4b: Summary of Simple Payback for Palo Alto Energy Measures

Building Description	Total Incremental First Cost (\$)	Incremental Annual Energy Cost Savings (\$)	Simple Payback (years)
42,320 sf (A)	\$42,295	\$6,036	7.0
42,320 sf (B)	\$43,945	\$6,155	7.1

Note 1: The average incremental first cost, Section 2.4, as compared with the Title 24 base case design.

Based on this data, the Ordinance increases the cost of this type of construction by approximately \$0.85 to \$1.20 per square foot, or approximately two- to three-tenths of one percent (0.2% to 0.3%).

Conclusions

Regardless of the building design, occupancy profile and number of stories, the incremental improvement in overall annual energy performance of buildings under the Palo Alto Green Building Ordinance is cost-effective. However, each building's specific design, occupancy type and the design choices used to meet the state's energy code -- and then go beyond it to meet the Ordinance -- may allow for a large range of incremental first cost and payback. As is the case in just meeting the requirements of the state's Title 24 energy standards, a permit applicant complying with the energy requirements of the Palo Alto Green Building Ordinance should carefully analyze building energy performance to reduce incremental first cost and reduce the payback for the required additional energy measures.

4.0 Credit for Solar PV Systems

Under the LEED rating system, and after all energy standards requirements have been met, additional energy credit for on-site solar photovoltaic (PV) electricity generation is available . The Ordinance defines the amount of credit for solar PV systems according to the latest version of the Commission's CECPV Calculator developed for the New Solar Homes Partnership (NSHP) program which can be downloaded at http://www.gosolarcalifornia.ca.gov/nshpcalculator/download_calculator.html ; or any other SB1 compliant calculation method approved by the Commission may be used.

The CF-1R-PV form, including all relevant PV system input assumptions and installation criteria, must be printed out and submitted to the building official as part of the other energy documentation. The installing contractor must meet all applicable installation criteria specified in the NSHP Guidelines for California 's Solar Electric Incentive Program Pursuant to Senate Bill 1 at <http://www.gosolarcalifornia.org>.

Note: The Ordinance makes clear that any building must meet the 2005 Building Energy Efficiency Standards without PV credit.

5.0 Implementation Plan

The implementation of the City of Palo Alto energy ordinance for residential buildings is a simple verification that the performance CF-1R for low-rise residential buildings or the PERF-1 for high-rise residential buildings shows that the proposed building exceeds Title 24 standards by at least 15%. If the building is to receive additional energy points under GreenPoint Rated (GPR) beyond the minimum 30 points, then the amount by which the building exceeds the standards is specified.

If a residential solar PV system is to receive a separate credit under GreenPoint Rated, the additional CF-1R-PV form must also be included.

For nonresidential buildings, only LEED requirements apply. The Ordinance also grants authority to the Chief Building Official to approve an “alternative equivalent method” to meet the LEED minimum energy performance requirement that the permit applicant may use instead of using the Energy Cost Budget method calculation that LEED requires. There will be a special compliance form which can be printed out from an Excel spreadsheet available from the City of Palo Alto, or be completed on a pre-printed form provided by the building department.

The City of Palo Alto 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 regular Title 24 documentation under the 2005 Building Energy Efficiency Standards; and,
- (c) Checking any additional special compliance forms needed to demonstrate compliance with the Ordinance.

Field inspection will be essentially identical to working with the current standards, with the inclusion of the possible inspection of a solar PV system.

Gabel Associates will work in conjunction with the City of Palo Alto to plan implementation, including, if requested, training for the building department, local energy consultants and interested parties (e.g., designers and builders) who would like to learn more about how to meet the Ordinance’s energy requirements.

6.0 Text of the Palo Alto Ordinance

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF PALO ALTO
ADDING CHAPTER 16.18 OF TITLE 16 OF THE PALO ALTO
MUNICIPAL CODE ESTABLISHING LOCAL ENERGY EFFICIENCY
STANDARDS FOR CERTAIN BUILDINGS AND IMPROVEMENTS
COVERED BY THE 2005 CALIFORNIA ENERGY CODE

The City Council of the City of Palo Alto does ORDAIN as follows:

SECTION 1. Findings. The City Council finds that:

1. The City of Palo Alto's (City) Comprehensive Plan sets forth goals for preserving and improving the City's natural and built environment, protecting the health of its residents and visitors, conserving water and energy, and fostering its economy; and
2. The City Council has identified Environmental Protection as one of its top four goals, and energy efficiency is a key component of environmental protection; and
3. The City's Climate Protection Plan, adopted by the City Council on December 3, 2007, states that natural gas and electricity use within the City accounts for approximately 310,000 metric tons of carbon dioxide emissions annually, or 42.5% of total annual City-wide emissions; and
4. The provisions of California Assembly Bill 32 (Global Warming Solutions Act) require actions on the part of State and local governments to significantly reduce greenhouse gas (GHG) emissions such that statewide GHG emissions are lowered to 1990 levels in 2020 and 80% below 1990 levels in 2050; and
5. The GHG emissions from the community from electricity and gas use have declined 13% since 1990 due in part to more efficient use of energy as well as a decline in economic activity, and
6. Local government, by itself, cannot fully address all of the challenges posed by climate change and comply with the mandates of AB 32; and
7. Energy efficiency is a key component in reducing GHG emissions, and construction of more energy efficient buildings can help Palo Alto reduce its share of the GHG emissions that contribute to climate change; and
8. On May 12, 2008, the City Council adopted regulations for the incorporation of green building techniques and materials in private residential and nonresidential development projects (Green Building Regulations), Ordinance No. 5006; and
9. California Health and Safety Code Sections 18938 and 17958 provide that the California Building Standards Code establishes building standards for all occupancies throughout the State; and

10. Health and Safety Code Section 17958.5 provides that a city may establish more restrictive building standards if they are reasonably necessary due to local climatic, geological or topographical conditions; and

11. Based on the findings contained in this Ordinance, the City Council has found that certain modifications and additions to the California Building Standards Code are reasonably necessary based upon local climatic, topographical and geological conditions; and

12. On November 26, 2007 the City Council adopted the 2005 Edition of the California Energy Code, codified in Chapter 16.17 of Title 16 of the City of Palo Alto Municipal Code; Ordinance No. 4980, and

13. California Public Resource Code Section 25402.1(h)(2) authorizes a city to adopt and enforce increased energy efficiency standards, provided that a determination is made that the local standards are cost effective and they are approved by the California Energy Commission; and

14. On May 5, 2008 the City hired Gabel Associates, LLC, an expert in the field of building energy analysis and Energy Code compliance, to assist the City in preparing a study and proposal for local amendments to the 2005 California Energy Code, and said study demonstrated the cost effectiveness of these local amendments; and

15. The City will include the Gabel Associates study in an application for consideration by the California Energy Commission in compliance with Public Resources Code 25402.1(h)(2); and

16. In accordance with the 2005 California Building Energy Efficiency Standards, including California Code of Regulations, Title 24, Parts 1 and 6 (Standards) all low-rise residential development must meet or exceed the energy efficiency requirements contained therein; and

17. It is the purpose and intent of this Ordinance to amend the Standards as described herein; and

18. City staff has prepared a new Chapter 16.18 to Title 16 of the Palo Alto Municipal Code, Local Energy Efficiency Standards; and

19. The modifications to the 2005 California Building Energy Efficiency Standards required by this Ordinance are reasonably necessary due to local climatic, geologic and topographic conditions, specifically:

- a. The City of Palo Alto Utilities (CPAU) is the only municipal utility in California that operates City-owned utility services including electric, fiber optic, natural gas, water and wastewater services, and as such, the City Council is uniquely concerned that CPAU be able to provide reliable power to Palo Alto residents and businesses, especially in periods of peak energy demand.

- b. Summer ambient temperatures in the City during the months of June, July and August can reach over 100 degrees, creating peak energy load demands that can cause power outages, affecting public safety and causing adverse local economic impacts.
- c. The total square footage of conditioned habitable space within residential and nonresidential buildings in the City is increasing and using more energy and resources than in the past.
- d. The burning of fossil fuels used in the generation of electric power and heating of buildings contributes to global warming, which could result in rises in sea level, including in San Francisco Bay, that could put at risk Palo Alto homes and businesses, public facilities, and Highway 101.
- e. Reduction of total and peak energy use as a result of incremental energy efficiency measures required by this Ordinance will have local and regional benefits in the cost-effective reduction of energy costs for building owners, additional available system energy capacity, and a reduction in greenhouse gas emissions.

20. In order to maintain and advance the energy efficiency standards adopted herein, it is in the best interest of the City to revisit this Ordinance prior to its expiration, ensuring that local energy standards meet the goals of reducing energy consumption, thereby saving on energy bills and decreasing greenhouse gas emissions.

21. The study conducted by Gabel Associates, LLC has concluded that the energy efficiency measures contained in this Ordinance are cost-effective. The City Council hereby adopts the conclusions of the study and authorizes its inclusion in an application for consideration by the California Energy Commission in compliance with Public Resources Code 25402.1(h)(2). Upon approval by the California Energy Commission, this Ordinance shall be presented to the City Council for final adoption.

SECTION 2. Chapter 16.18 of Title 16, "Building Code," is hereby added to the Palo Alto Municipal Code to read and provide as follows:

Chapter 16.18

LOCAL ENERGY EFFICIENCY STANDARDS FOR CERTAIN BUILDINGS AND IMPROVEMENTS COVERED BY THE 2005 CALIFORNIA ENERGY CODE

Sections:

16.18.010	Purpose.
16.18.020	Definitions.
16.18.030	Buildings Covered.
16.18.040	Compliance.
16.18.050	General Compliance Requirements.
16.18.060	Expiration.

16.18.010 Purpose.

The purpose of this Ordinance is to promote the health, safety and welfare of Palo Alto residents, workers, and visitors by minimizing the use and waste of energy in the construction and operation of the City's building stock. The Ordinance sets forth minimum energy efficiency standards within the City of Palo Alto for all new residential and non-residential construction, and should be used in conjunction with the City's Green Building Regulations, located in Chapter 18.44 of Title 18 (Zoning) of the Palo Alto Municipal Code. This Chapter is intended to amend the 2005 California Building Energy Efficiency Standards, as specified in the California Code of Regulations, Title 24, Parts 1 and 6 (Standards), adopted by the City at Title 16, Chapters 16.04 and 16.17 of the Palo Alto Municipal Code. Compliance with the 2005 California Building Energy Efficiency Standards is required even if the increased minimum efficiency standards in this Chapter do not apply.

16.18.020 Definitions.

For purposes of this Chapter 16.18, words or phrases used in this Chapter that are specifically defined in Parts 1, 2 or 6 of Title 24 of the California Code of Regulations shall have the same meaning as given in the Code of Regulations. In addition, for the purposes of this Chapter 16.18, the following words and phrases shall have the meanings indicated herein:

- (a) "2005 Building Energy Efficiency Standards" shall mean the Standards and regulations adopted by the California Energy Commission contained in Parts 1 and 6 of Title 24 of the California Code of Regulations as such standards and regulations may be amended from time to time.
- (b) "GreenPoint Rated" shall mean a residential green building rating system developed by the Build It Green organization.
- (c) "LEED®" shall mean the "Leadership in Energy and Environmental Design" green building rating system developed by the U.S. Green Building Council.
- (d) "Multi-Family Residential" shall mean a building containing three or more attached dwelling units.
- (e) "Nonresidential" shall mean the construction of a new or replacement retail, office, industrial, warehouse, service, or similar building(s).

(f) “Nonresidential Compliance Manual” shall mean the manual developed by the California Energy Commission, under Section 25402.1(e) of the Public Resources Code, to aid designers, builders, and contractors in meeting the requirements of the state’s 2005 Building Energy Efficiency Standards for nonresidential, high-rise residential, and hotel/motel buildings.

(g) “Residential Compliance Manual” shall mean the manual developed by the California Energy Commission, under Section 25402.1(e) of the Public Resources Code, to aid designers, builders, and contractors in meeting the requirements of the state’s 2005 Building Energy Efficiency Standards for low-rise residential buildings.

(h) “Single-Family or Two-Family Residential” shall mean a single detached dwelling unit or two units in a single building.

(i) “Solar Photovoltaic Energy System” shall mean a photovoltaic solar collector or other photovoltaic solar energy device that has a primary purpose of providing for the collection and distribution of solar energy for the generation of alternative current rated peak electricity.

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

16.18.030 Buildings Covered.

The provisions of this Ordinance shall apply to all new residential construction (including Multi-Family, Single-Family and Two-Family Residential construction) and all new Nonresidential construction (including Mixed Use and other development), of any size for which a building permit has been applied and accepted as complete by the Chief Building Official on or after the effective date of this Ordinance. This Ordinance shall not apply to residential and nonresidential additions and renovations of any size or permit valuation. Subject to the foregoing limitation, the coverage of this Chapter shall be determined in accordance with the scope and application of either the Residential Compliance Manual or the Nonresidential Compliance Manual, as appropriate for the proposed occupancy.

16.18.040 Compliance.

The Chief Building Official shall be charged with enforcing the provisions of this Ordinance. A building permit application subject to the provisions of this Chapter shall not be issued a building permit by the Chief Building Official unless the energy compliance documentation submitted with the permit application meets the requirements of this Chapter. A final inspection for a building permit subject to the requirements of this Chapter will not be approved unless the work authorized by the building permit has been constructed in accordance with the approved plans, conditions of approvals, and requirements of this Chapter.

16.18.050 General Compliance Requirements.

In addition to the requirements of the 2005 Building Energy Efficiency Standards, the following general compliance requirements shall apply to all building permit applications subject to this chapter:

(a) **Single-Family and Two-Family Residential Buildings.** When an application for a building permit involves a new Single Family or Two-Family Residential building that is also a low-rise building, as defined by the 2005 California Building Energy Efficiency Standards, the performance approach specified in Section 151 of the 2005 Building Energy Efficiency Standards must be used to demonstrate that the TDV Energy of the proposed building is at least 15.0% less than the TDV Energy of the standard building. Compliance with this Section shall constitute achievement of the minimum GreenPoint Rated energy points required for new “Single-Family and Two-Family Residential” construction, as described in Table B of the “City of Palo Alto Green Building Standards for Compliance for Private Development – Residential Construction and Renovation”.

(b) **Multi-Family Residential Buildings.** When an application for a building permit involves a new Multi-Family Residential Building, the building permit applicant must determine whether the building is low-rise or high-rise as defined by the 2005 California Building Energy Efficiency Standards, and then use the appropriate approach as described below:

(1) *Low Rise Multi-Family Residential Buildings.* When an application for a building permit involves a new low-rise Multi-Family Residential Building, the performance approach specified in Section 151 of the 2005 California Building Energy Efficiency Standards must be used to demonstrate that the TDV Energy of the proposed building is at least 15.0% less than the TDV Energy of the standard building. Compliance with this Section shall constitute achievement of the minimum GreenPoint Rated energy points required for new “Multi-Family Residential” construction, as described in Table B of the “City of Palo Alto Green Building Standards for Compliance for Private Development – Residential Construction and Renovation”.

(2) *High-Rise Multi-Family Residential Buildings.* When an application for a building permit involves a new high-rise Multi-Family Residential Building, the applicant must meet the Performance Approach using a Building Envelope and Mechanical System energy budget calculation methodology to demonstrate the compliance with the requirements of this Chapter, as described below:

(i) **Performance Approach/Building Envelope and Mechanical System.** The applicant must model the building envelope and mechanical system using a state-approved energy compliance software program and demonstrate that the TDV Energy of the sum of the Space Heating, Space Cooling, Indoor Fans, Pump, Heat Rejection and DHW energy components of the proposed building is at least 15.0% less than the TDV Energy of the sum of the Space Heating, Space Cooling, Indoor Fans, Pump, Heat Rejection and DHW energy components of the standard building. Compliance with this Section shall constitute achievement of the minimum GreenPoint Rated energy points required for new “Multi-Family Residential” construction as described in Table B of the “City of Palo Alto Green Building Standards for Compliance for Private Development – Residential Construction and Renovation.”

(c) **Nonresidential Buildings.** When an application for a building permit involves new Nonresidential Construction, as described in Table A of the “City of Palo Alto Green Building Standards for Compliance for Private Development – Nonresidential Construction and Renovation,” the permit applicant may choose to meet the LEED® minimum energy performance requirement, or may choose to meet the minimum energy performance requirements with an alternative equivalent method approved by the Chief Building Official.

(d) **Solar Photovoltaic Energy Systems for Multi-Family Residential Construction and Nonresidential Construction.** The installation of any solar photovoltaic (PV) energy system must meet all installation criteria of the California Energy Commission’s Guidelines for California’s Solar Electric Incentive Programs Pursuant to Senate Bill 1. An energy credit from solar PV energy systems may be used to demonstrate compliance with the general compliance requirements of this Ordinance when evaluating LEED® energy performance. This credit is available if the solar PV energy system is capable of generating electricity from sunlight, supplying the electricity directly to the building, and the system is connected, through a reversible meter, to the utility grid. The methodology used to calculate the energy equivalent to the photovoltaic credit shall be the CECPV Calculator, using the most recent version available prior to the permit application date, which may be found on the web site of the California Energy Commission, at www.gosolarcalifornia.org; or shall be another Senate Bill 1 compliant method as approved by the California Energy Commission.

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

16.18.060 Expiration.

This Chapter 16.18 shall expire upon the date that the state’s 2008 Building Energy Efficiency Standards take effect.

SECTION 2. Severability. Should any section, subsection, paragraph, sentence, clause, or phrase of this Ordinance be declared unconstitutional or invalid for any reason, such declaration shall not affect the validity of the remaining portions of this Ordinance.

SECTION 3. Efforts to Enhance Local Compliance. Given that the purpose of this Ordinance is to adopt stricter local energy efficiency standards for the construction of new buildings within the City, the Council further recognizes that the adoption of new standards without additional education and training for City staff responsible for enforcement of the standards could diminish compliance and potentially undermine the efficacy of the Ordinance. Therefore, in order to ensure greater compliance and enforcement of the applicable energy efficiency standards, better equip staff and provide a greater resource to the City’s building community, the City will seek additional education and training opportunities for staff in the areas of energy standards, technology and Energy Code implementation and enforcement.

SECTION 4. Environmental Compliance. The proposed Ordinance preserves and enhances the environment, in that it would set forth minimum energy efficiency standards within the City of Palo Alto for all new residential and nonresidential construction. In accordance with California Environmental Quality Act (CEQA) Section 15061(b)(3), “[C]EQA applies only to projects which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA.” Staff has determined that the proposed Ordinance is exempt from CEQA review.

SECTION 5. Effective Date. This Ordinance shall be in full force and effective 30 days after its adoption, provided that the Ordinance has also been approved by the California Energy Commission by that date, and shall be published or posted as required by law.

INTRODUCED:

PASSED:

AYES:

NOES:

ABSTENTIONS:

ABSENT:

ATTEST:

APPROVED:

City Clerk

Mayor

APPROVED AS TO FORM:

City Manager

Deputy City Attorney

Director of Planning & Community
Environment

Director of Utilities