GREEN BUILDING in Alameda County

Energy Cost-effectiveness Study*

Executive Summary

Purpose of the Study:

Stopwaste.Org's Green Building in Alameda County program commissioned this Energy Cost-effectiveness study on behalf of their member agencies. This report can be used by Alameda County jurisdictions wishing to adopt mandatory energy policy(ies) that exceed the State's Building Energy Efficiency Standards 2008 Title 24 part 6 (T-24 2008) scheduled to be effective on August 1st, 2009. In order to adopt policies requiring energy efficiency beyond T-24 2008, a cost effectiveness study and findings must be approved by the California Energy Commission (CEC) and filed with the California Building Standards Commission (BSC).

It's important to note that separate local climatic, geological, or topographical findings must be filed with the BSC for adopted local policies that require building standards that are different and more restrictive than the California Green Building Standards Code.

This report can be referenced in the CEC/BSC filing process and should eliminate the need for each individual City in Alameda County to replicate this analysis. The report includes energy cost-effectiveness analysis using case studies of several building designs that meet and exceed T-24 in the two California climate zones within Alameda County: 3 & 12. Gabel Associates, LLC was contracted to conduct the energy analysis and summary report, and Building Advisory, LLC was contracted to conduct cost research referenced in the report.

Summary of Methodology:

The data in this cost-effectiveness study has been developed and compiled to consider code change cost implications to new construction projects in Climate Zones 3 and 12 for single family residential, multifamily low-rise residential, multifamily high-rise residential and non-residential office buildings. For each prototype new construction building the measures and associated incremental cost necessary to reach 10%, 15%, 20%, and 35% above code are itemized, and the cost-effectiveness for each scenario is presented in graph format.

The percent better than code compliance is per the T-24 performance approach in the T-24 2008 code beta versions of the MICROPAS and EnergyPro compliance alternative calculations method (ACM) software programs. These ACM software programs report energy savings in the metric of time dependent valuation (TDV) kBtu/sf-year. TDV kBtu/sf-year is the energy savings metric from which site energy in KWh and Therms is calculated for each performance scenario to establish the annual energy savings, energy cost savings and CO2-equivalent reductions in greenhouse gases.

* This document summarizes a more comprehensive document authored by Gabel

ATTACHMENT E

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% better than Title 24). The energy measures chosen are not all the prescriptive measures, but are a combination of measures, which reflect how designers, builders and developers are likely to achieve a specified level of performance. A minimum and maximum range of incremental costs of added energy measures is established by a variety of research and surveys to obtain accurate and current measure cost.

Results of the Study:

The case study analysis provides a limited set of data representing the impact that the T-24 2008 code update will have on the cost for projects to go beyond minimum code compliance. Figures 1-5 on the following pages summarize the cost/square foot and the average cost for projects to meet these thresholds above the new code.

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.

Single Family Home Cost Effectiveness Summary

Two Homes at 10%, 15%, 20% & 35% above the T-24 2008 Standards in Climate Zones 3 & 12

Home # 1 = 1,582 square feet

Home # 2 = 2,025 square feet

Climate Zone 3										
Home Size (square feet)		#1 =	1,582				#2 =	2,025		
% > T-24	**Meet Code**	**10%**	**15%**	**20%**	**35%**	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f.****	$0.15	$0.64	$1.19	$1.33	$2.14	$0.69	$0.69	$0.77	$0.87	$2.03
Ave. $/home	$237.30	$1,012.48	$1,882.58	$2,104.06	$3,385.48	$1,397.25	$1,397.25	$1,559.25	$1,761.75	$4,110.75
CZ 3 Average of Home #1 & #2										
%> T-24	Meet Code	10%	15%	20%	35%					
Ave. of Both Homes	$817.28	$1,204.87	$1,720.92	$1,932.91	$3,748.12					

Climate Zone 12										
Home Size (square feet)		#1 =	1,582				#2 =	2,025		
% > T-24	**Meet Code**	**10%**	**15%**	**20%**	**35%**	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f.****	$0.52	$0.60	$1.10	$1.94	$5.38	$0.48	$0.60	$1.18	$1.69	$4.92
Ave. $/home	$822.64	$949.20	$1,740.20	$3,069.08	$8,511.16	$972.00	$1,215.00	$2,389.50	$3,422.25	$9,963.00
CZ 12 Average of Home #1 & #2										
%> T-24	**Meet Code**	**10%**	**15%**	**20%**	**35%**					
Ave. of Both Homes	$897.32	$1,082.10	$2,064.85	$3,245.67	$9,237.08					

Average of Climate Zones 3 & 12					
%> T-24	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. of Both Climate Zones	**$857.30**	**$1,143.48**	**$1,892.88**	**$2,589.29**	**$6,492.60**
	~$850	~$1,150	**~$1,900**	~$2,600	~$6,500

On Average, the incremental cost per single family home to exceed T-24 2008 by 15% is $1,900.

The "Meet Code" columns show the incremental cost per single family home to go from minimally compliant T-24 2005 to minimally compliant T-24 2008. On average, the incremental cost to meet the new code is $850.

Figure 1

Low-rise Multifamily Cost Effectiveness Summary

One prototype multifamily building at 10%, 15%, 20% & 35% above the T-24 2008 Standards in Climate Zones 3 & 12

2 story, 8 units, 8,442 s.f.

Climate Zone 3					
Building Size (square feet)	8,442				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f.	$0.14	$0.54	$1.42	$1.58	$1.86
Ave. $/unit (8 units/building)	$147.74	$569.84	$1,498.46	$1,667.30	$1,962.77

Climate Zone 12					
Building Size (square feet)	8,442				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f.	$0.37	$1.07	$1.80	$2.37	$4.20
Ave. $/unit (8 units/building)	$390.44	$1,129.12	$1,899.45	$2,500.94	$4,432.05

Average of Climate Zones 3 & 12					
Building Size (square feet)	8,442				
%> T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f. both climate zones	$0.26	$0.81	$1.61	$1.98	$3.03
Ave. $/unit (8 units/building)	**$269.09**	**$849.48**	**$1,698.95**	**$2,084.12**	**$3,197.41**
	~$270	~$850	**~$1,700**	~$2,000	~$3,000

On Average, the incremental cost per multifamily unit to exceed T-24 2008 by 15% is $1,700.

The "Meet Code" columns show the incremental cost per multifamily building to go from minimally compliant T-24 2005 to minimally compliant T-24 2008. On average, the incremental cost per multifamily dwelling unit to meet the new code is $300.

Figure 2

High-rise Multifamily Cost Effectiveness Summary

One prototype High-rise Residential building at 10%, 15%, 20% & 35% above the T-24 2008 Standards in Climate Zones 3 & 12

5 story, 40 units, 26,800 s.f.

Climate Zone 3					
Building Size (square feet)	26,800				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f.	$0.00	$0.86	$1.18	$2.66	$5.40
Ave. $/unit (40 units/building)	$0.00	$907.52	$1,245.20	$2,806.97	$5,698.35

Climate Zone 12					
Building Size (square feet)	26,800				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f.	$0.00	$0.58	$0.76	$2.66	$4.69
Ave. $/unit (40 units/building)	$0.00	$612.05	$801.99	$2,806.97	$4,949.12

Average of Climate Zones 3 & 12					
Building Size (square feet)	26,800				
%> T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**35%**
Ave. $/s.f. both climate zones	$0.00	$0.72	$0.97	$2.66	$5.05
Ave. $/unit (40 units/building)	**$0.00**	**$759.78**	**$1,023.59**	**$2,806.97**	**$5,323.74**
	~$0*	~$760	**~$1,000**	~$2,800	~$5,300

On Average, the incremental cost per high-rise residential unit to exceed T-24 2008 by 15% is $1,000.

* The "Meet Code" columns show the incremental cost per multifamily building to go from minimally compliant T-24 2005 to minimally compliant T-24 2008. On average, the incremental cost per multifamily dwelling unit to meet the new code is $0. In the Beta version of EnergyPro available at the time this analysis was conducted, the 2005 code Highrise Multifamily project also complied with the 2008 code and therefore showed no incremental cost. In the final version of EnergyPro with the residential (waterheating) code changes incorporated, we anticipate that there will be some incremental cost to meet the new code.

Figure 3

Non-Residential Cost Effectiveness Summary

One prototype low-rise office building at 10%, 15%, 20% & 25% above the T-24 2008 Standards in Climate Zones 3 & 12

2 story, 21,160 s.f.

Climate Zone 3					
Building Size (square feet)	21,160				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**25%**
Ave. $/s.f.	$0.73	$0.91	$2.35	$3.98	$4.34
Ave. $/building	$770.33	$960.28	$2,479.84	$4,199.90	$4,579.79

Climate Zone 12					
Building Size (square feet)	21,160				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**25%**
Ave. $/s.f.	$1.46	$0.95	$2.11	$2.61	$3.89
Ave. $/building	$1,540.67	$1,002.49	$2,226.58	$2,754.20	$4,104.92

Average of Climate Zones 3 & 12					
Building Size (square feet)	21,160				
%> T-24 2008	**Meet Code**	**10%**	**15%**	**20%**	**25%**
Ave. $/s.f. both climate zones	$1.10	$0.93	$2.23	$3.30	$4.12
Ave. $/building both climate zones	**$1,155.50**	**$981.38**	**$2,353.21**	**$3,477.05**	**$4,342.35**
	~$1,150	**~$1,000**	~$2,300	~$3,500	~$4,300

The "Meet Code" columns show the incremental cost per non-residential office building to go from minimally compliant T-24 2005 to minimally compliant T-24 2008.

Figure 4

Non-Residential Cost Effectiveness Summary

One prototype high-rise office building at 10%, 15% & 20% above the T-24 2008 Standards in Climate Zones 3 & 12

5 story, 52,900 s.f.

Climate Zone 3				
Building Size (square feet)				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**
Ave. $/s.f.	$0.36	$0.79	$1.74	$2.25
Ave. $/building	$379.89	$833.65	$1,836.14	$2,374.31

Climate Zone 12				
Home Size (square feet)				
% > T-24 2008	**Meet Code**	**10%**	**15%**	**20%**
Ave. $/s.f.	$1.01	$0.95	$1.01	$1.89
Ave. $/building	$1,065.80	$1,002.49	$1,065.80	$1,994.42

Average of Climate Zones 3 & 12				
%> T-24 2008	**Meet Code**	**10%**	**15%**	**20%**
Ave. $/s.f. both climate zones	**$0.69**	**$0.87**	**$1.38**	**$2.07**
Ave. of Both Climate Zones	**$722.85**	**$918.07**	**$1,450.97**	**$2,184.37**
	~$700	**~$900**	~$1,500	~$2,100

The "Meet Code" columns show the incremental cost per highrise non-residential office building to go from minimally compliant T-24 2005 to minimally compliant T-24 2008.

Figure 5

Policy Recommendations:

When developing and implementing an energy efficiency or green building ordinance, we recommend the following:

- Performance vs. Prescriptive Approach

The performance approach to energy compliance should be implemented in all local ordinances for residential and nonresidential. There are two approaches to meet the energy code: the performance approach and the prescriptive approach. In order to show a project exceeds the energy code, California State requires a performance approach to meet a threshold percentage better than T-24. While the prescriptive approach is essentially a list of measures and can appear to be easier to implement, it doesn't provide a mechanism to determine the most cost-effective set of energy efficiency measures for each unique project. For these reasons, the performance approach showing a percentage of performance better than T-24 is used in a large variety of applications such as:

- Utility incentive programs
- State tax credits for solar PV systems (NSHP program)
- GreenPoint Rated program
- LEED rating system
- Local energy ordinances
- Low Income Housing Tax Credits
- ENERGY STAR New Homes
- Federal energy efficiency tax credits
- HERS Phase 2 for Existing and New Homes (2010)

Conversely, we strongly recommend against a local ordinance requiring prescriptive measures that can be modeled in the performance method because it does not allow building designers flexibility in deciding which energy measures, in combination and for the lowest cost, meet the overall energy budget for the building. The prescriptive approach's limitation on project decisions, and perceived preference towards specific energy saving products, could cause legal disputes with constituents and product manufacturers.

- Title 24 Analysis, Metric and Forms

Use Title 24 methods, rules, software and reports wherever possible, augmented only when necessary to comply with or document a special energy credit.

- LEED Energy Performance

Any local ordinance which references LEED should provide an administrative mechanism whereby a permit applicant can meet the minimum energy LEED requirement with a designated Title 24 energy equivalent performance.

- Energy Efficiency before On-site Generation

Only award solar PV credit after a building has already achieved the minimum energy efficiency performance. Energy efficiency is a more cost-effective investment to achieve green house gas reductions than on-site generation as documented in numerous studies, including the California

Public Utility Commission's (CPUC) 2020 Strategic Plan and the California Air Resources Board's (CARB) AB32 draft scoping plan.

We also recommend that, to ensure consistency with State programs and maximum benefit to applicants seeking to apply for available incentives, a local energy ordinance that includes provisions for PV meet all installation criteria in the "Guidelines for California's Solar Electric Incentive Programs Pursuant to Senate Bill 1." The methodology used to calculate the energy equivalent to the solar PV credit shall be the CECPV Calculator using the most recent version prior to the permit application date, which may be found at: http://www.gosolarcalifornia.ca.gov/nshpcalculator/.

- Certified Energy Plans Examiners (CEPEs)

The California Association of Building Energy Consultants (CABEC) sponsors and administers the Certified Energy Plans Examiner (CEPE) program for the Residential and Nonresidential Standards. CEPE candidates must pass an examination to demonstrate knowledge of the applicable standards.

Local ordinances can include a requirement, or create a permit incentive, for the energy analysis and documentation to be prepared by an individual with the current applicable CEPE credential.

State Review of Local Adopted Energy Standards

This cost effectiveness study and findings can be submitted by Cities in Alameda County to the California Energy Commission (CEC) and filed with the California Building Standards Commission (BSC) in the process described below. The following summarizes the steps of creating and implementing a local energy ordinance, or a green building ordinance which includes energy requirements, that exceed the California Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24, Part6):

1. Establish Ordinance (city/county staff)
2. Conduct Cost Effectiveness Study (city/county staff or consultant)
3. First Reading of Ordinance (City Council or Board of Supervisors)
4. Application to the California Energy Commission (CEC)
5. Second Reading of Ordinance (City Council or Board of Supervisors)
6. File with the California Building Standards Commission (BSC)
7. Implementation and Enforcement (city/county staff)

1. Establish Ordinance

Include the following findings in the ordinance:

- A clear policy statement outlining the green building or energy goals for each building type covered
- A general understanding of the relative impact on increased construction costs of the proposed ordinance

- A plan including the adoption timeline and approach for enforcement by the local building department

Specify thresholds for the more stringent energy requirements as defined by the following building permit scenarios:

- New construction vs. Additions vs. Alterations
- Occupancy type
- Number of stories and/or building height
- Total conditioned floor area

Note that the cost effectiveness study in this report only applies to *new construction*, a separate analysis would be required for existing buildings.

2. Cost Effectiveness Study

The jurisdiction makes an independent judgment as to the levels of energy efficiency appropriate for their permit applicants, usually requiring projects to be between 10% to 20% more energy efficient than Title 24, Part 6 depending on occupancy type and costs. A jurisdiction may choose for the ordinance to refer to one or more green building rating systems, such as LEED and GreenPoint Rated, which have standard minimum energy efficiency requirements for new construction and those requirements then become the basis for the local ordinance.

The energy cost-effectiveness study is a consideration of the incremental first cost to achieve the required percentage above code as compared to the annual energy cost savings for the various building types. The cost-effectiveness study should inform the energy efficiency thresholds as part of the supporting documentation provided to members of the City Council or Board of Supervisors prior to the vote on the ordinance. The Energy Cost-effectiveness study satisfies this requirement.

3. First Reading of Ordinance

An ordinance must have preliminary local approval *before* the application to the CEC can be submitted for state review. In most cases, that means a "first reading" or "introduction" of an ordinance, and its initial approval by the City Council or Board of Supervisors prior to its final adoption at a later date.

4. Application to the California Energy Commission (CEC)

Public Resources Code section 25402.1(h)(2) and the California Code of Regulations, Title 24, Part 1, Article 1, Section 10-106 establish that no local energy ordinance can be legally enforced unless the CEC first reviews the ordinance and finds that it "will require the diminution of energy consumption levels permitted by [Title 24].". The following is the full text of section 10-106:

SECTION 10-106 – LOCALLY ADOPTED ENERGY STANDARDS

(a) Requirements. Local governmental agencies may adopt and enforce energy standards for newly constructed buildings, additions, alterations, and repairs provided the Commission finds that the standards will require buildings to be designed to consume no more energy than

permitted by Part 6. Such local standards include, but are not limited to, adopting the requirements of Part 6 before their effective date, requiring additional energy conservation measures, or setting more stringent energy budgets. Local adoption of the requirements of Part 6 before their effective date is a sufficient showing that the local standards meet the requirements of this section and Section 25402.1(f)(2) of the Public Resources Code; in such a case only the documentation listed in Section 10-106(b), and a statement that the standards are those in Part 6, need be submitted.
(b) Documentation Application. Local governmental agencies wishing to enforce locally adopted energy conservation standards shall submit four copies of an application with the following materials to the executive director:
1. The proposed local energy standards.
2. A study with supporting analysis showing how the local agency determined energy savings.
3. A statement that the local standards will require buildings to be designed to consume no more energy than permitted by Part 6.
4. The basis of the agency's determination that the standards are cost effective.
NOTE: Authority cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

The findings in the ordinance and scope of the cost-effectiveness study are at the discretion of the local jurisdiction. See example approved ordinances at: http://www.energy.ca.gov/title24/2005standards/ordinances_exceeding_2005_building_standards.html

CEC staff will review the ordinance, and may have comments or request clarification of language that they interpret as unclear or potentially in conflict with Title 24 Standards. From the date that the CEC receives an application expect a minimum of two to three months until formal review by the Commission. CEC's required findings generally do not require the presence of local jurisdiction staff to be present in Sacramento to respond to questions or comments by the Commissioners although they are welcome to be present if they wish. They may also listen in to Energy Commission Business Meetings via the weblink at: http://www.energy.ca.gov/calendar/events/index.php?com=detail&eID=30

5. Second Reading by City Council or Board of Supervisors

Final adoption of the ordinance by the local jurisdiction can occur any time after the date of CEC review of findings.

6. File with the California Building Standards Commission (BSC)

After the local energy ordinance has been adopted, it must be filed with the California Building Standards Commission (BSC). The BSC is responsible for administering California's building codes, including adopting, approving, publishing, and implementing codes and standards. However, the BSC does not review the energy ordinance or formally vote on it. The BSC clerk simply receives it and files it and nothing further.

NOTE: S*eparate* local climatic, geological, or topographical findings have to be filed with BSC for mandatory green building polices and ordinances that are more restrictive than the California Green Building Standards Code. This process is different than the one outlined in this document.

StopWaste.Org is developing Model Findings for its member agencies that will be available in March 2009.

7. Implementation and Enforcement

The effective date of the ordinance is generally 30 days (or some other specified number of days) after final ordinance adoption. Implementation of the ordinance requires building department staff training and resources such as:

- A concise summary of the local energy ordinance requirements for the building department to provide to permit applicants
- Provision for a clear methodology to meet green building program (e.g. LEED, GreenPoint Rated) energy requirements based on Title 24 calculations and documentation
- Clarification of how to calculate the extent to which a building exceeds Title 24 for specific building types
- Additional forms to supplement the standard Title 24 energy compliance report
- A commitment to improve enforcement of the Title 24 Standards as well as the requirements of the local ordinance