Presentation:

American Institute of Architecture-

Orange County

December 3rd, 2013

California Green Code Changes-

July 2012/Jan 2014

& LEED EB:OM 2009

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Cal Green Code Changes
and
LEED 2009

Greenerade Index

Summary of Cal Green Enforcement Changes As of

Jul 2012 & Jan 2014

Additions and Alterations to Existing Buildings

Division 5.7 – Additions and alterations to existing nonresidential buildings

- ~~July 1, 2012~~ : 2,000 sq ft additions, $500,000 alterations
- 2013 Code: 1,000 sq ft additions, $200,000 alterations
- New Division 5.7 Additions and alterations to existing nonresidential buildings" (State definitions)

DIVISION 5.7 ADDITIONS AND ALTERATIONS TO EXISTING NONRESIDENTIAL BUILDINGS

This is a new division proposed to include standards for additions and alterations to existing nonresidential buildings. The reason for this proposal is to extend the benefits of reduction in greenhouse gas emissions, water use, and polluting finish products to a larger class of buildings than newly constructed buildings. It is modeled after similar provisions recently adopted locally by the City of Los Angeles for its considerable body of construction projects. It proposes and scopes some of the provisions from Divisions 5.3 through 5.5 for which cost benefit analysis was prepared last cycle for the mandatory code. The provisions are those readily applicable to additions and renovations.

SECTION 5.701 – ADMINISTRATION

CALGreen Section: 5.701.1 Scope. For those occupancies subject to section 103 of this code, the provisions of this division shall apply to the planning, design, operation, construction, use and occupancy of additions to buildings or structures unless otherwise indicated in this code. The provisions of this Division shall only apply to the portions of the building being added or altered within the scope of the permitted work. Compliance for additions and alterations is required on or after the dates shown in Table 5.701

TABLE 5.701

Effective date of compliance	**Square footage of addition**	**Permit valuation or estimated construction cost of alteration**
July 1, 2012	2000	$500,000
Effective date of the 2013 California Building Standards Code	1000	$200,000

Notes:

1) The effective date of the 2013 California Building Standards Code is currently projected to be January 1, 2014.
2) This division does not apply to additions and alterations of qualified historical buildings.

Intent: Scope for additions and alterations to existing nonresidential buildings is limited to 2000 s.f. for additions and $500,000 for alterations, with that limit to drop in the next edition of the code. At the request of the Division of the State Architect, this section also includes an exception for qualified historic buildings regulated by that agency.

Existing Law or Regulation:

Building standards generally apply to additions and alterations for which a permit is applied. CALGreen has an exception, applying only to newly constructed buildings, so this division aligns CALGreen with other Parts of Title 24. There may be a more stringent local ordinance in place.

Compliance Method:

Determine if the addition or alteration triggers compliance (see Section 5.701 above and Section 7.502 Definitions) then comply with the specific provisions applicable.

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the plans, specifications for the areas of additions and construction cost estimates for alterations for to confirm the need for compliance.

On-Site Enforcement: The inspector should review the permit set of plans and product data sheets for compliance with specific provisions, following.

SECTION 5.702 – DEFINITIONS

CALGreen Section: 5.702.1 Definitions. Unless otherwise stated, the following words and terms shall, for the purposes of this code, have the meanings shown in this division. Refer also to definitions in Chapter 2 of this code.

ADDITION. An extension or increase in floor area of an existing building or structure.

ALTERATION OR ALTER. Any construction or renovation to an existing structure other than repair for the purpose of maintenance or addition.

ARB (CARB). The California Air Resources Board.

Intent:
Section 5.702.1 Definitions.
CBSC is including definitions of addition and of alteration, which are exclusive of each other, taken from the building Code.

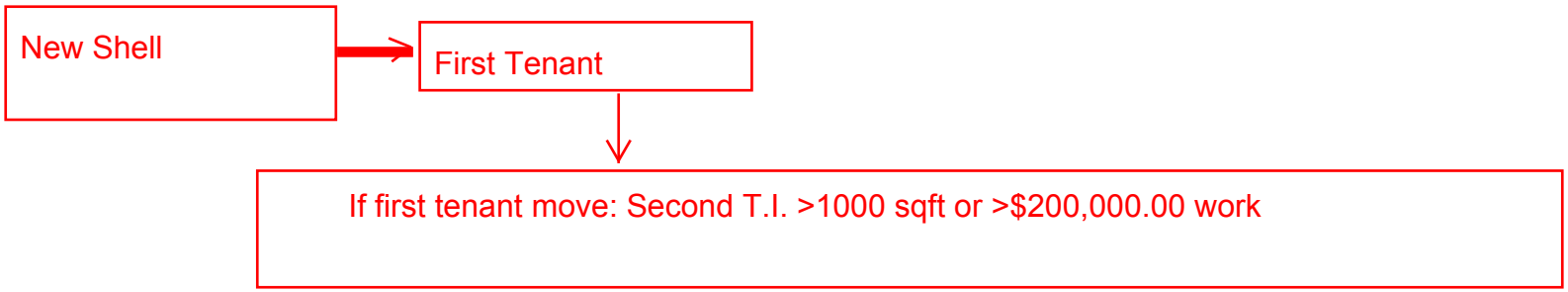
SECTION 5.703 GREEN BUILDING

CALGreen Section: 5.703.1 Scope. Building additions and alterations shall be designed to include the green building measures specified as mandatory in the application checklists for alterations or additions contained in this code.

5.703.2 Phased projects. For shell buildings and others constructed for future tenant improvements, only those code measures relevant to the building components and systems considered to be new construction (or newly constructed) shall apply.

5.703.2.1 Tenant improvements. The provisions of this code shall apply to the initial tenant or occupant improvements to a project and to subsequent tenant improvements subject to Section 5.701.1.

Intent:
Section 5.703.1 Scope.
CBSC is proposing that the mandatory provisions in this division be found in the checklists in the appendix in the code.
Section 5.703.2 Phased projects and **5.703.2.1 Tenant improvements.** CBSC is proposing to clarify for the code user the application of the provisions of this division to shell buildings and tenant improvements.


New Shell
First Tenant
If first tenant move: Second T.I. >1000 sqft or >$200,000.00 work

Very Detailed Non-Residential Chapter 5

Planning and Design

Planning and Design		
Site Development		**Changes**
5.106.1	Stormwater pollution prevention BMP	*Clarifies that it also applies to additions*
5.106.4	Bicycle parking	*Updated for additions and alterations*
	Light pollution reduction	*Clarifies that it applies to new construction only*
	Grading and paving	*Exception: for additions and alterations*

5.106.1 Stormwater pollution prevention.

Require BMP's instead of designed plan

CALGreen Section: 5.106.10 Grading and Paving. Construction plans shall indicate how site grading or a drainage system will manage all surface water flows to keep water from entering buildings. Examples of methods to manage surface water include, but are not limited to, the following:

1. Swales
2. Water collection and disposal systems
3. French drains
4. Water retention gardens
5. Other water measures which keep surface water away from buildings and aid in groundwater recharge

Intent:
The intent of this code provision is to ensure that newly constructed project sites are planned and developed to keep surface water from entering the building, to extend the longevity of the exterior building walls, to prevent mold and keep moisture from entering the exterior wall and perimeter slabs.

Change for 2012: This provision is being modified slightly to emphasize means of compliance. Grading and paving plans, typically required by enforcing agencies, will show how this is to be accomplished, and a list of methods for managing flows, aligned with the Department of Housing and Community Development's (HCD) section, has been added.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision. However, there are some code sections in the California Building Code (for example Section *1805.3.4* Foundation elevation) that address sloping grades away from buildings but does not address how all surface water flows will be managed on site.

Compliance Method:
Show on the construction documents (site plan or grading plan) how site grading and/or a drainage system will manage all surface water flows to keep water from entering the building. This is particularly critical on sloped sites.

Suggestion: *Show on the grading plan, in addition to draining the water away from the exterior walls, how surface water will be managed on site. Methods include but are not limited to, those now listed in the regulation.*

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the grading plan and confirm that there are slopes away from the building and adequate measures to manage surface water flows. In addition, the reviewer should ensure that the plans indicate protection from water intrusion for buildings located on sloped sites or having flood plain requirements.

On-Site Enforcement: The inspector should review the permit set of plans to verify that all grading and/or drainage systems have been installed as specified on the approved plans and specifications.

SECTION 5.710 – PLANNING AND DESIGN SECTION 5.710.6 SITE DEVELOPMENT

CALGreen Section: 5.710.6.1 Storm water pollution prevention. Additions that disturb soil of less than one acre shall prevent the pollution of stormwater runoff from the construction activities through one or more of the following measures:

5.106.1.1 Local ordinance. Comply with a lawfully enacted stormwater management and/or erosion control ordinance.

5.106.1.2. Best management practices (BMP). Prevent the loss of soil through wind or water erosion by implementing an effective combination of erosion and sediment control and good housekeeping BMP.

1. Soil loss BMP that should be considered for implementation as appropriate for each project include, but are not limited to, the following:
   a. Scheduling construction activity
   b. Preservation of natural features, vegetation and soil
   c. Drainage swales or lined ditches to control stormwater flow
   d. Mulching or hydroseeding to stabilize disturbed soils
   e. Erosion control to protect slopes
   f. Protection of storm drain inlets (gravel bags or catch basin inserts)
   g. Perimeter sediment control (perimeter silt fence, fiber rolls)
   h. Sediment trap or sediment basin to retain sediment on site
   i. Stabilized construction exits
   j. Wind erosion control
   k. Other soil loss BMP acceptable to the enforcing agency

2. Good housekeeping BMP to manage construction equipment, materials, and wastes that should be considered for implementation as appropriate for each project include, but are not limited to, the following:
   a. Material handling and waste management
   b. Building materials stockpile management
   c. Management of washout areas (concrete, paints, stucco, etc.)
   d. Control of vehicle/equipment fueling to contractor's staging area
   e. Vehicle and equipment cleaning performed off site
   f. Spill prevention and control
   g. Other housekeeping BMP acceptable to the enforcing agency

Intent:
The intent of this section means to prevent pollution from storm water runoff similar to that for new construction, where an addition disturbs less than one acre of soil. It recognizes that a local ordinance may govern, and it adds best management practices that can be used to prevent soil loss. This brings renovation projects in line with new construction projects disturbing similar amounts of soil to prevent soil and sediment from entering receiving waters.

Compliance and Enforcement: See **§ 5.106.1** of this guide

5.106.4 Bicycle parking.

Delete reference to UC Policy on Sustainable Practices

CALGreen Section: 5.106.4 Bicycle parking. Comply with Sections 5.106.4.1 and 5.106.4.2; or meet local ordinance, whichever is stricter.

5.106.4.1 Short-term bicycle parking. If the project is anticipated to generate visitor traffic, provide permanently anchored bicycle racks within 200 feet of the visitors' entrance, readily visible to passers-by, for 5 percent of visitor motorized vehicle parking capacity, with a minimum of one two-bike capacity rack.

5.106.4.2 Long-term bicycle parking. For buildings with over 10 tenant-occupants, provide secure bicycle parking for 5 percent of motorized vehicle parking capacity, with a minimum of one space. Acceptable parking facilities shall be convenient from the street and may include:

1. Covered, lockable enclosures with permanently anchored racks for bicycles;
2. Lockable bicycle rooms with permanently anchored racks; and
3. Lockable, permanently anchored bicycle lockers.

Note: Additional information on recommended bicycle accommodations may be obtained from Sacramento Area Bicycle Advocates.

Intent:
The intent of this code provision is to ensure that newly constructed projects provide short term and/or long term bicycle parking accommodations to promote the use of bicycles as an alternate means of transportation in an attempt to reduce greenhouse gas emissions.

Change for 2012: The proposed modification deletes, at the request of the University of California, a reference to the University of California Policy on Sustainable Practices.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision. However, there are some jurisdictions that have adopted local ordinances.

Compliance Method:
Short-Term Bicycle Parking:
Construction documents (plans & specifications and/or site plan) should reflect the location of the required number of short-term permanently anchored bicycle parking racks for 5 percent of visitor motorized vehicle parking capacity, with a minimum of one two-bike capacity rack.

Long-Term Bicycle Parking:

1. Determine which of the three options will be used to comply or identify an alternate method(s).
2. Construction documents (plans & specifications and/or site plan) should reflect the method and location of the required number of long-term secured bicycle parking facilities based on **5 percent of motorized** vehicle parking capacity, with a minimum of one space.

Note: *If the applicant is seeking a parking capacity reduction under §A5.106.6, or the local jurisdiction has a zoning ordinance for reduced parking, use the parking requirements that apply before the reduction is taken or outside any special zone in the calculations. This is to recognize that, with reduced parking capacity, more people are likely to ride bicycles.*

Suggestion: *Provide a calculation table or a note on the plans showing the total number of required short-term spaces by multiplying the anticipated visitor parking spaces by 5 percent and for long-term spaces by multiplying the total vehicular parking required spaces by 5 percent.*

Examples:

*Short-term: Visitor parking capacity at **42 x 5 percent =2.1** – Provide racks for 3 bicycles. Long-term: Total Vehicular parking capacity at **216 x 5 percent =10.8 –Provide 11 spaces.***

If specifying lockers, consider using six two-bicycle lockers.

Enforcement:

Plan intake: The reviewer and/or plan checker should review the plans and confirm that the correct number of bicycle parking racks and/or secured areas are included with the drawings and meet the requirements.

On-Site Enforcement: The inspector should review the permit set of plans to verify that all required bicycle parking requirements as shown on the plans have been provided and installed.

CALGreen Section: 5.710.6.2 Bicycle parking. Comply with Sections 5.710.6.2.1 and 5.710.6.2.2; or meet the applicable local ordinance, whichever is stricter.

5.710.6.2.1 Short-term bicycle parking. If the project is anticipated to generate visitor traffic and adds 10 or more vehicular parking spaces, provide permanently anchored bicycle racks within 200 feet of the visitors' entrance, readily visible to passers-by, for 5% of the additional visitor motorized vehicle parking capacity, with a minimum of one two-bike capacity rack.

5.710.6.2.2 Long-term bicycle parking. For buildings with over 10 tenant-occupants that add 10 or more vehicular parking spaces, provide secure bicycle parking for 5% of additional motorized vehicle parking capacity, with a minimum of one space. Acceptable parking facilities shall be convenient from the street and may include:

1. Covered, lockable enclosures with permanently anchored racks for bicycles;
2. Lockable bicycle rooms with permanently anchored racks; and
3. Lockable, permanently anchored bicycle lockers.

Intent:
The Intent of this section and subsections require additional bicycle parking when 10 or more parking spaces are added as part of an addition or alteration project, thus encouraging additional building occupants to use alternate forms of transportation to standard automobiles.

Compliance and Enforcement: See **§ 5.106.4** of this guide

5.106.5.2 Designated parking.
Marking: “CLEAN AIR/VANPOOL/EV” instead of “CLEAN AIR VEHICLE”

CALGreen Section: 5.106.5.2 Designated parking. Provide designated parking for any combination of low-emitting, fuel efficient, and carpool/van pool vehicles as follows:

[Table 5.106.5.2 not shown – refer to Code]

5.106.5.2.1 Parking stall marking. Paint, in the paint used for stall striping, the following characters such that the lower edge of the last word aligns with the end of the stall striping and is visible beneath a parked vehicle:

CLEAN AIR/ VANPOOL/EV

Note: Vehicles bearing Clean Air Vehicle stickers from expired HOV lane programs may be considered eligible for designated parking spaces.

Intent:
This code provision is to ensure that newly constructed projects provide designated parking for clean air vehicles (low-emitting, fuel efficient, and carpool/van pool vehicles) which gives reserved parking to those who drive clean air vehicles. The intent is to promote the use of clean air vehicles in an attempt to conserve natural resources and reduce green house gas emissions.

Clean Air Resource Board

Change for 2012: 2012 modifications, proposed by CARB, are to delete the definition for a PZEV vehicle, which does not qualify, and change the stall marking designation to read **CLEAN AIR/VANPOOL/EV** to reflect qualifying vehicles that shall be permitted to park there. Based on comment made at the Green Building Code Advisory Committee (GB CAC), CBSC has worked with ARB to shorten the stall marking language and clarify which vehicles are eligible for the parking.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision. However, there are some jurisdictions that have adopted ordinances.

Compliance Method:

Design Team: Construction documents (site plan) should reflect the location of the required number of designated parking stalls with the marking "CLEAN AIR/VANPOOL/EV" toward the back of the stall, similar to an accessible symbol, so that the writing can be seen when a clean air vehicle is parked. Lettering should be at least 8 inches high. The parking stalls can be located anywhere on the site without preferential location.

Suggestion: *The plans should reflect the total number of required vehicular spaces and refer to TABLE 5.106.5.2 to ensure that the correct number of designated parking stalls is being provided. Include all parking spaces in the calculation. As approved by the enforcing agency, some compact stalls may also be marked for clean air vehicles.*

Examples:

1. ***55 total parking spaces:*** *based on TABLE 5.106.5.2 – Provide 6 clean air/vanpool/ev spaces which fall within the range.*
2. ***240 total parking spaces:*** *based on TABLE 5.106.5.2, calculate 240 x 8 percent = 19.2 – Provide 20 clean air/vanpool/ev spaces.*

8%

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the plans and confirm that the correct number and configuration of "CLEAN AIR/VANPOOL/EV" parking stalls are included on the drawings.

On-Site Enforcement: The inspector should review the permit set of plans to verify that the correct number of clear air vehicle parking stalls have been provided and marked.

CALGreen Section: 5.710.6.3 Designated parking. For projects that add 10 or more vehicular parking spaces, provide designated parking for any combination of low-emitting, fuel- efficient, and carpool/van pool vehicles as shown in Table 5.106.2.2 of Division 5.1 based on the number of additional spaces.

5.106.5.2.1 Parking stall marking. Paint, in the paint used for stall striping, the following characters such that the lower edge of the last word aligns with the end of the stall striping and is visible beneath a parked vehicle:

CLEAN AIR/ VANPOOL/EV

Note: Vehicles bearing Clean Air Vehicle stickers from expired HOV lane programs may be considered eligible for designated parking spaces.

Intent:
Change for 2012: The intent of this section and subsections requires additional designated parking stalls when 10 or more parking spaces are added as part of an addition or alteration project, thus encouraging additional building occupants to use alternate forms of transportation to standard automobiles.

Compliance and Enforcement: See **§ 5.106.5.2** of this guide

5.106.8 Light pollution reduction.
Now Mandatory (previously - Voluntary)
IESNA TM-15-11 2011, TABLE 5.106.8 for allowable BUG ratings

CALGreen Section: 5.106.8 Light pollution reduction. Outdoor lighting systems shall be designed and installed to comply with the following:

1. The minimum requirements in the California Energy Code for Lighting Zones 1-4 as defined in Chapter 10 of the California Administrative Code; and
2. Backlight, Uplight and Glare (BUG) ratings as defined in IESNA TM-15-11; and
3. Allowable BUG ratings not exceeding those shown in Table 5.106.8, or Comply with a local ordinance lawfully enacted pursuant to Section 101.7, whichever is more stringent.

Exceptions:
1. Luminaries that qualify as exceptions in Section 147 of the California Energy Code
2. Emergency lighting

Note: See also California Building Code, Chapter 12, Section 1205.6 for college campus lighting requirements for parking facilities and walkways.

5.106.8.1 Effective date. Newly constructed nonresidential projects with outdoor lighting for which an application for a building permit is submitted on or after July 1, 2012 shall comply with this section.

TABLE 5.106.8

[Table not shown for clarity, refer to Code]

Intent:
The intent of this code provision is to ensure that newly constructed projects reduce the amount of light and glare from both interior and exterior light sources leaving the site. This is to minimize light pollution in order to maintain our dark skies.

Change for 2012: This section is proposed to be moved from the voluntary Appendix A5 where it was located after modification in a recent emergency rulemaking. Problems with the version published in the 2010 code were identified as potential threats to public safety due to inadequate site illumination. In the intervening months between the emergency rulemaking and the effective date of the 2012 supplement, it should have been tested for utility and ease of compliance and enforcement as a voluntary standard when it becomes mandatory in its new format.

Existing Law or Regulation:

There are several existing codes that are being referenced in this provision as follows:

1. Lighting power requirements in the California Energy Code, CCR, Title 24, Part 6.
2. Lighting zone characteristics and lighting zones 1-4 as defined in Chapter 10 of the California Administrative Code, CCR Title 24, Part 1.
3. California Building Code, CCR title 24, Part 2 Section 1205.6 exception regarding campus lighting for parking and walkways.
4. The latest standards of the Illuminating Engineers Society in TM-15-11.

Compliance Method:

FIRST:

Comply with California Energy Commission regulations in Part 1 and Part 6 cited above. Those standards form a basis upon which to build for the purpose of light pollution reduction in addition to energy efficiency. The provisions in Part 1 provide a weighted approach to the project site location, with a project located in the middle of a big city allowed more light to escape than a project at a rural or urban location. Part 6 addresses power and energy efficiency of outdoor lighting. There are exceptions for certain occupancies for lighting power requirements which would apply to this provision, but voluntary compliance with any or all of the items is encouraged.

THEN:

To comply with this provision, either:

1. Consult and comply with a local dark skies ordinance, if more stringent than these regulations.
2. Specify exterior lighting fixtures that meet IESNA TM-15-11 regarding backlight, up light and glare. Rating may not exceed those values shown in Table 5.106.8

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the construction documents, including exterior light sources, to confirm compliance with Part 1, Part 2 and Part 6; review the electrical plans and specifications for complying building and exterior lighting, including photometric data for perimeter site lighting fixtures; and review specifications for any controls
to be installed on the project.

On-Site Enforcement: The inspector should review the permit set of plans to verify that all lighting and power calculations and specified products are installed as specified on the approved plans and specifications.

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BUILDING STANDARDS BULLETIN 11-02

DATE: April 26, 2011

LOCAL BUILDING OFFICIALS INTERESTED PARTIES

SUBJECT: CHANGES TO THE CALIFORNIA GREEN BUILDING STANDARDS ODE (CALGreen) REGARDING LIGHT POLLUTION REDUCTION

This bulletin is to bring attention to new requirements of the 2010 California Building Standards Code in Title 24, Part 11 of the California Code of Regulations (as also known as CALGreen). Specifically, the new requirement affects Chapter 5 - Nonresidential Mandatory Measures, Division 5.1, Section 5.106.8 Light pollution reduction.

The California Building Standards Commission (CBSC) at its April 19, 2011 meeting approved an emergency proposal submitted in response to a public petition regarding concerns over security aspects of the light pollution reduction provisions currently in effect in the 2010 CALGreen code.

The repealed language and modified language relocated to Appendix A5 via this emergency adoption, is reprinted herein for your reference. Please note that during the ensuing comment period which this provision is subject to, the language may be further amended.

Upon approval of the proposed emergency, the existing provisions in Section 5.106.8 were repealed and new requirements were approved. Proposed changes to the regulations include removal of language that presented public safety concerns and compliance difficulties in favor of referenced national standards.

This action corrects and simplifies the light pollution provisions and moves them to the voluntary appendix, with mandatory adoption delayed until July 1, 2012, to allow designers, builders and enforcing agencies time to adjust to the new standards. These emergency modifications were

made within CBSC authority, with necessary amendments, and in the interest of public safety.

Should you have questions or further clarification is needed concerning this bulletin, please feel free to contact our technical staff at (916) 263-0916 or through our contact e-mail address cbsc@dgs.ca.gov.

Dave Walls
Executive Director

(REPEAL LANGUAGE)

SECTION 5.106
SITE DEVELOPMENT

~~**5.106.8 Light pollution reduction.** Meet lighting power requirements in the California Energy Code, CCR, Title 24, Part 6, and design interior and exterior lighting such that zero direct beam illumination leaves the building site. Comply with lighting zones 1-4 and lighting zone characteristics as defined in Chapter 10 of the California Administrative Code, CCR, Title 24, Part 1, using the following strategies:~~
~~1. Shield all exterior luminaires or provide cutoff luminaires per Section 132 (b) of the California Energy Code.~~
~~2. Contain interior lighting within each source.~~
~~3. Allow no more than .01 horizontal footcandles to escape 15 feet beyond the site boundary.~~
~~4. Automatically control exterior lighting dusk to dawn to turn off or lower light levels during inactive periods.~~

~~**Exceptions:**~~
~~1. CCR, Title 24, Part 2, Chapter 12, Section 1205.6 for campus lighting requirements for parking facilities and walkways~~
~~2. Emergency lighting and lighting required for nighttime security~~

(NEW AMENDED LANGUAGE)

SECTION A5.106
SITE DEVELOPMENT

A5.106.8 Light pollution reduction. Outdoor lighting systems shall be designed and installed to comply with the following:
1. The minimum requirements in the California Energy Code for Lighting Zones 1-4 as defined in Chapter 10 of the California Administrative Code; and
2. Backlight, Uplight and Glare (BUG) ratings as defined in IESNA TM-15-07; and
3. Allowable BUG ratings not exceeding those shown in Table A5.106.8, or

Comply with a local ordinance lawfully enacted pursuant to Section 101.7, whichever is more stringent.

Exceptions:
1. Luminaires that qualify as exceptions in the California Energy Code
2. Emergency lighting

Note: See also California Building Code, Chapter 12, Section 1205.6 for college campus lighting requirements for parking facilities and walkways.

TABLE A5.106.8
Maximum Allowable Backlight, Uplight and Glare (BUG) Ratings[1]

Allowable Rating	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3
Allowed Backlight Rating			
Greater than 2 mounting heights from property line	B3	B4	B5
1 – 2 mounting heights from property line and oriented with B towards the property line	B2	B3	B4
0.5 – 1 mounting height from property line and oriented with B towards the property line	B1	B2	B3
Less than 0.5 mounting height from property line adjacent to a street and oriented with B towards the property line[2]	B0	B1	B2
Less than 0.5 mounting height from property line and oriented with B towards the property line	B0	B0	B1
Allowed Uplight Rating	U0	U1	U2
Allowed Glare Rating[2]	G1	G2	G3
Allowed Glare Rating, Building Mounted Luminaires[3]			
Greater than 2 mounting heights to any property line	G1	G2	G3
1 – 2 mounting heights to any property line	G0	G1	G1
0.5 – 1 mounting heights to any property line	G0	G0	G1
Less than 0.5 mounting height to any property line	G0	G0	G0

1 IESNA Lighting Zones 0 and 5 are not applicable; refer to Lighting Zones as defined in the California Energy Code and Chapter 10 of the California Administrative Code.

[2] For purposes of compliance with this section, the property line may be considered to be the centerline of a public roadway or transit line. For properties adjacent to public walkways, bikeways, plazas and parking lots, the property line may be considered to be five feet beyond the site boundary.

[3] Building-mounted luminaires that cannot be mounted with their backlight to the property line shall meet the Allowed Glare rating for all luminaires. Light from a building-mounted luminaire shall not exceed the Backlight rating in the direction of the property line.

Addendum A for IESNA TM-15-07: Backlight, Uplight, and Glare (BUG) Ratings

The following Backlight, Uplight, and Glare ratings may be used to evaluate luminaire optical performance related to light trespass, sky glow, and high angle brightness control. These ratings are based on a zonal lumen calculations for secondary solid angles defined in TM-15-07. The zonal lumen thresholds listed in the following three tables are based on data from photometric testing procedures approved by the Illuminating Engineering Society for outdoor luminaries (LM-31 or LM-35).

Table A-1: Backlight Ratings (maximum zonal lumens)

		Backlight Rating					
	Secondary Solid Angle	B0	B1	B2	B3	B4	B5
Backlight / Trespass	BH	110	500	1000	2500	5000	>5000
	BM	220	1000	2500	5000	8500	>8500
	BL	110	500	1000	2500	5000	>5000

Table A-2: Uplight Ratings (maximum zonal lumens)

		Uplight Rating					
	Secondary Solid Angle	U0	U1	U2	U3	U4	U5
Uplight / Skyglow	UH	0	10	100	500	1000	>1000
	UL	0	10	100	500	1000	>1000
	FVH	10	75	150	>150		
	BVH	10	75	150	>150		

Table A-3: Glare Ratings (maximum zonal lumens)

Glare Rating for Asymmetrical Luminaire Types (Type I, Type II, Type III, Type IV)

	Secondary Solid Angle	G0	G1	G2	G3	G4	G5
Glare / Offensive Light	FVH	10	250	375	500	750	>750
	BVH	10	250	375	500	750	>750
	FH	660	1800	5000	7500	12000	>12000
	BH	110	500	1000	2500	5000	>5000

Glare Rating for Quadrilateral Symmetrical Luminaire Types (Type V, Type V Square)

	Secondary Solid Angle	G0	G1	G2	G3	G4	G5
Glare / Offensive Light	FVH	10	250	375	500	750	>750
	BVH	10	250	375	500	750	>750
	FH	660	1800	5000	7500	12000	>12000
	BH	660	1800	5000	7500	12000	>12000

Notes to Tables A-1, A-2, and A-3:

(1) Any one rating is determined by the maximum rating obtained for that table. For example, if the BH zone is rated B1, the BM zone is rated B2, and the BL zone is rated B1, then the *backlight rating for the luminaire* is B2.

(2) To determine BUG ratings, the photometric test data must include data in the upper hemisphere unless no light is emitted above 90 degrees vertical (for example, if the luminaire has a flat lens and opaque sides), per the IES Testing Procedures Committee recommendations.

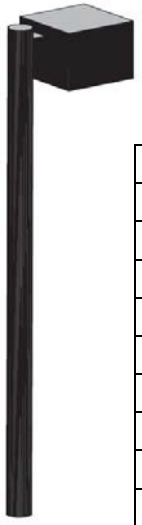
(3) It is recommended that the photometric test density include values at least every 2.5 degrees vertically. If a photometric test does not include data points every 2.5 degrees vertically, the BUG ratings shall be determined based on appropriate interpolation.

(4) A “quadrilateral symmetric” luminaire shall meet one of the following definitions:

a. A Type V luminaire is one with a distribution that has circular symmetry, defined by the IESNA as being essentially the same at all lateral angles around the luminaire.

b. A Type VS luminaire is one where the zonal lumens for each of the eight horizontal octants (0-45, 45-90, 90-135, 135-180, 180-225, 225-270, 270-315, 315-360) are within ±10 percent of the average zonal lumens of all octants.

"BUG" RATING EXAMPLE:



A 250-watt MH area luminaire, Type IV forward throw optical distribution. Based on the photometric test data, the luminaire has the following zonal lumen distribution:

Forward Light	**Lumens**	**% Lamp Lumens**
FL (0 - 30 degrees)	1618	5.9%
FM (30 - 60 degrees)	6093	22.2%
FH (60 – 80 degrees)	3748	13.6%
FVH (80 – 90 degrees)	27	0.1%
Back Light		
BL (0 – 30 degrees)	985	3.6%
BM (30 – 60 degrees)	930	3.4%
BH (60 – 80 degrees)	136	0.5%
BVH (80 – 90 degrees)	16	0.1%
Uplight		
UL (90 – 100 degrees)	0	0.0%
UH (100 – 180 degrees)	0	0.0%

Backlight Rating: Determine the lowest rating where the lumens for all of the secondary solid angles do not exceed the threshold lumens from **Table A-1**. In this example the backlight rating would be **B2** based on the BL lumen limit.

Uplight Rating: Determine the lowest rating where the lumens for all of the secondary solid angles do not exceed the threshold lumens from **Table A-2**. In this example the uplight rating would be **U1** based on the FVH and BVH lumen limits.

Glare Rating: Determine the lowest rating where the lumens for all of the secondary solid angles do not exceed the threshold lumens from **Table A-3** for a Type IV distribution. In this example, the glare rating would be **G2** based on the FH lumen limit.

Therefore, the BUG rating for this luminaire would be: **B2 U1 G2**

5.106.10 Grading and paving.

Provides examples such as swales and french drains. "No generic Notes"

CALGreen Section: 5.106.10 Grading and Paving. Construction plans shall indicate how site grading or a drainage system will manage all surface water flows to keep water from entering buildings. Examples of methods to manage surface water include, but are not limited to, the following:

1. Swales ; 2. Water collection and disposal systems; 3. French drains., 4. Water retention gardens
5. Other water measures which keep surface water away from buildings and aid in groundwater recharge

Intent:
The intent of this code provision is to ensure that newly constructed project sites are planned and developed to keep surface water from entering the building, to extend the longevity of the exterior building walls, to prevent mold and keep moisture from entering the exterior wall and perimeter slabs.

Change for 2012: This provision is being modified slightly to emphasize means of compliance. Grading and paving plans, typically required by enforcing agencies, will show how this is to be accomplished, and a list of methods for managing flows, aligned with the Department of Housing and Community Development's (HCD) section, has been added.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision. However, there are some code sections in the California Building Code (for example Section *1805.3.4* Foundation elevation) that address sloping grades away from buildings but does not address how all surface water flows will be managed on site.

Compliance Method:
Show on the construction documents (site plan or grading plan) how site grading and/or a drainage system will manage all surface water flows to keep water from entering the building. This is particularly critical on sloped sites.

Suggestion: *Show on the grading plan, in addition to draining the water away from the exterior walls, how surface water will be managed on site. Methods include but are not limited to, those now listed in the regulation.*

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the grading plan and confirm that there are slopes away from the building and adequate measures to manage surface water flows. In addition, the reviewer should ensure that the plans indicate protection from water intrusion for buildings located on sloped sites or having

flood plain requirements.

On-Site Enforcement: The inspector should review the permit set of plans to verify that all grading and/or drainage systems have been installed as specified on the approved plans and specifications.

CALGreen Section: 5.710.10 Grading and Paving. Construction plans shall indicate how site grading or a drainage system will manage all surface water flows to keep water from entering buildings. Examples of methods to manage surface water include, but are not limited to, the following:

1. Swales
2. Water collection and disposal systems
3. French drains
4. Water retention gardens
5. Other water measures which keep surface water away from buildings and aid in groundwater recharge

Exception: Additions and alterations not altering the drainage path.

Intent:
The intent of this section, including BMP aligned with HCD, has been included for compliance where grading and paving occur as part of an addition or alteration project altering the drainage path, protecting those structures from surface water.

This provision intends to emphasize means of compliance. Grading and paving plans, typically required by enforcing agencies, will show how this is to be accomplished, and a list of methods for managing flows, aligned with the Department of Housing and Community Development's (HCD) section, has been added.

Compliance and Enforcement: See **§ 5.106.10** of this guide

Water Efficiency and Conservation

Indoor water Use		**Changes**
	Separate water submeters for subsystems	*Clarifies that it also applies to additions*
	20% reduction is indoor water use	*New sections: "Water Reduction": Comply with reduced flow rate table;*
	Prescriptive and performance standards with updated tables	*"Water conserving plumbing fixtures and fittings": Prescriptive reduced flow rates for: water closets, Urinals, and Showerheads and*
		Clarifies that it applies to effected areas of additions and alterations
		New Exceptions for performance 20% reduction
	Waste water reduction	*Clarifies that it applies to new construction only*
	Plumbing fixtures and fittings (standards)	*New Section: References The California Pluming Code*

5.303.1 Buildings in excess of 50,000 square feet Option for sub-metering of cooling towers, evaporative coolers and boilers

DIVISION 5.3 WATER EFFICIENCY AND CONSERVATION

SECTION 5.303 INDOOR WATER USE

CALGreen Section: 5.303.1 Meters. Separate submeters or metering devices shall be installed for the uses described in Sections 5.303.1.1 and 5.303.1.2.

5.303.1.1 Buildings in excess of 50,000 square feet (4645 m^2). Separate submeters shall be installed as follows:

1. For each individual leased, rented, or other tenant space within the building projected to consume more than 100 gal/day (380 L/day), including, but not limited to, spaces used for laundry or cleaners, restaurant or food service, medical or dental office, laboratory, or beauty salon or barber shop.
2. Where separate submeters for individual building tenants are unfeasible, for water supplied to the following subsystems:
   a. Makeup water for cooling towers where flow through is greater than 500 gpm (30 L/s)
   b. Makeup water for evaporative coolers greater than 6 gpm (0.04 L/s)
   c. Steam and hot-water boilers with energy input more than 500,000 Btu/h (147 kW)

5.303.1.2 Excess consumption. Any building or a space within a building that is projected to consume more than 1,000 gal/day (3800 L/day).

Intent:
The intent of this code provision is to reduce potable water use in new buildings by making building owners and/or tenants aware of their daily potable water consumption to encourage voluntary reduction of potable water use. Note: Owner billing of tenants based on actual use is not intended but is not prohibited.

Change for 2012: CBSC is proposing the amendment of this section to provide clarity to the code user regarding the use of meters, submeters, and metering devices. For buildings in excess of 50,000 s.f., the amendments consolidate the language for tenants expected to use more than 100 gal/day, and they add submetering for specified subsystems where it is unfeasible to meter individual tenants. These provisions also apply to certain additions and alterations per Division 5.7.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision.

Compliance Method:
First determine if the new project will require separate meters based on the 50,000 square foot or excess consumption regulation. If so then:

1. Determine if your leased, rented, or other tenant space within the 50,000 square foot building (including spaces used for laundry or cleaners, restaurant or food service, medical or dental office, laboratory, or beauty salon or barber shop) is projected to consume more than 100 gal/day. If so, then provide separate submeters to be installed by the owner or contractor after the main meter supplied by the utility.
2. If any building within a project or space within a building is projected to consume more than 1,000 gal/day then provide a separate submeter or metering devices. Examples are car washes and aquariums.
3. If separate meters for tenants is infeasible, for example, in some high-rise projects, separately meter instead any of the applicable systems listed.

Suggestion: *Show separate meters on the plans (Site Utility Plan) and provide specifications for the submeters and/or metering devices.*

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that separate meters and/or metering devices are specified on the plans when required.

On-Site Enforcement: The inspector should review the permit set of plans to verify that all separate submeters and/or metering devices are installed as specified on the approved plans and specifications.

5.303.2 20% reduction in indoor water use.

Include residential lavatory faucets in table and clarification for showerheads.

CALGreen Section: 5.303.2 20 percent savings. A schedule of plumbing fixtures and fixture fittings that will reduce the overall use of potable water within the building by 20 percent shall be provided. The reduction shall be based on the maximum allowable water use per plumbing fixture and fittings as required by the California Building Standards Code. The 20 percent reduction in potable water use shall be demonstrated by one of the following methods.

1. Prescriptive method. Each plumbing fixture and fitting shall not exceed the maximum flow rate at ≥20 percent reduction as specified in Table 5.303.2.3, or
2. Performance method. A calculation demonstrating a 20% reduction in the building "water use baseline" as established in Table 5.303.2.2 shall be provided.

[Tables 5.303.2.2 and 5.303.2.3 are not shown for clarity, but these footnotes have been added to the tables:

Footnotes for Table 5.303.2.2:

[2] Refer to Table A, Chapter 4, California Plumbing Code, for occupant load factors.

(a) Shower use by occupants depends on the type of use of a building or portion of a building, e.g., total occupant load for a health club, but only a fraction of the occupants in an office building as determined by the anticipated number of users.

(b) Nonresidential kitchen faucet use is determined by the occupant load of the area served by the fixture.

Footnotes for Table 5.303.2.3:

[1] Lavatory Faucets Residential shall not have a flow rate less than 0.8 gpm at 20 psi.

[2] Kitchen faucets may temporarily increase flow above the maximum rate, but not above 2.2 gpm @ 60 psi and must default to a maximum flow rate of 1.8 gpm @ 60 psi.

[3] Where complying faucets are unavailable, aerators rated at .35 gpm or other means may be used to achieve reduction.

Intent :

The intent of this code provision is to reduce the overall use of potable water within the building by 20 percent. Governor Schwarzenegger issued a proclamation in 2009 making 20 percent water use reduction a statewide goal.

Change for 2012: 5.302.2. 20 percent savings, Table 5.303.2.2, and **Table 5.303.2.3**. CBSC is proposing the modification of these sections and tables in response to comments from CARB and to coordinate language with HCD. Changes include clarifications to prescriptive and performance measures, identification of baseline flow rates in the tables, deletion of the word "Indoor" from the title of Table 5.303.2.2, and correction of the duration of a nonresidential shower in the table.

and

Proposed also are footnotes to Table 5.303.2.2 clarifying number of occupants to be considered shower or kitchen faucet users in commercial applications. Being deleted is footnote 2 to Table 5.303.2.2, which referenced the California Energy Commission Appliance Efficiency Standards in Title 20 as the source of most baseline flow rates, as superfluous, since the baseline flow rates are shown in the tables. Proposed for Table 5.303.2.3 is a new footnote to advise code users of means of compliance for nonresidential faucets, the baseline of which is also the lowest flow rate currently available from manufacturers.

Existing Law or Regulation:

AB 715 (Stats 2007, c. 499) modified the Health and Safety Code to allow only high-efficiency toilets and urinals to be sold or installed after January 1, 2014.

Compliance Method:

Demonstrate a 20 percent reduction in potable water use by using one of the following methods:
1. Prescriptive Method: Refer to Table 5.303.2.3 and select the plumbing fixtures and fittings with the reduced flow rates.
OR

Performance Method: Refer to Table 5.303.2.2 and provide a calculation demonstrating a 20 percent reduction in the building "water use baseline" as established in the table.

Suggestion: *For the Prescriptive Method, provide a note on the plans and specify the fixtures and fittings that meet the requirement. For the Performance Method, provide a plumbing calculation on the plans demonstrating an overall 20 percent water use reduction.*

Sample worksheets are included in Chapter 8 of the code and in Part 4 of this Guide.

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that either the prescriptive or performance method has been submitted and check for the 20 percent water reduction compliance. If the performance method is used, review the water calculations showing the 20 percent reduction.

On-Site Enforcement: The inspector should review the permit set of plans to verify that the specified water efficient plumbing fixtures and fixture fittings are installed. If the performance method was used, the inspector will verify that fixtures or systems used to reduce overall water use by 20 percent have been installed. The inspector may review the fixture specifications to verify compliance or accept a self-certification form.

	Table 5.303.2.2 *(Duplicated form 2010 CGBC)* INDOOR WATER USE BASELINE[4]			
FIXTURE TYPE	FLOW RATE[2]	DURATION	DAILY USES	OCCUPANTS[3]
Showerheads	2.5 gpm @ 80psi	8 min.	1	X
Lavatory faucets, nonresidential	0.5 gpm @ 60 psi	.25 min.	3	X
Kitchen faucets	2.2 gpm @ 60 psi	4 min.	1	X
Replacement aerators	2.2 gpm @ 60 psi			X
Wash fountains	2.2 [rim space (in.)/20 gpm @ 60 psi]			X
Metering faucets	0.25 gallons/cycle	.25 min.		X
Metering faucets for wash fountains	.25 [rim space (in.)/20 gpm @ 60 psi	.25		X
Gravity tank-type water closets	1.6 gallons/flush	1 flush	1 male[1] 3 female	X
Flushometer tank water closets	1.6/gallons/flush	1 flush	1 male[1] 3 female	X
Flushometer valve water closets	1.6 gallons/flush	1 flush	1 male[1] 3 female	X
Electromechanical hydraulic water closets	1.6 gallons/flush	1 flush	1 male[1] 3 female	X
Urinals	1.0 gallon/flush	1 flush	2 male	X
	Fixture "Water Use"=Flow rate X Duration X Occupants X Daily uses			

1. The daily use number shall be increased to three if urinals are not installed in the room.
2. The flow rate is from the CEC Appliance Efficiency Standards, Title 20, California Code of Regulations; where a conflict occurs, the CEC standards shall apply.
3. Refer to Table A, Chapter 4, California Plumbing Code, for occupant load factors.
4. Use Worksheet WS-1 to calculate base line water use.

	Table 5.303.2.3 *(Duplicated from 2010 CGBC)* FIXTURE FLOW RATES	
FIXTURE TYPE	FLOW RATE	MAXIMUM FLOW RATE AT ≥20 PERCENT REDUCTION
Showerheads	2.5 gpm @ 80 psi	2 gpm @ 80 psi
Lavatory faucets, nonresidential	0.5 gpm @ 60 psi	0.4 gpm @ 60 psi
Kitchen faucets	2.2 gpm @ 60 psi	1.8 gpm @ 60 psi
Wash fountains	2.2 [rim space (in.)/20 gpm @ 60 psi]	1.8 [rim spce (in.)/20 gpm @ 60 psi
Metering faucets	0.25 gallons/cycle	0.2 gallons/cycle
Metering faucets for wash fountains	.25 [rim space (in.)/20 gpm @ 60 psi]	.20 [rim space (in.)/20 gpm @ 60 psi]

Gravity Tank-type water closets	1.6 gallons/flush	1.28 gallons/flush[1]
Flushometer tank water closets	1.6 gallons/flush	1.28 gallons/flush[1]
Flushometer valve water closets	1.6 gallons/flush	1.28 gallons/flush[1]
Electromechanical hydraulic water closets	1.6 gallons/flush	1.28 gallons/flush[1]
Urinals	1.0 gallon/flush	.5 gallon/flush

1. *Includes single and dual flush water closets with an effective flush of 1.28 gallons or less:*
   Single flush toilets – The effective flush volume shall not exceed 1.28 gallons (4.8 liters). The effective flush volume is the average flush volume when tested in accordance with ASME A112.19.233.2.
   Dual flush toilets – The effective flush volume shall not exceed 1.28 gallons (4.8 liters). The effective flush volume is defined as the composite, average flush volume of two reduced flushes and one full flush. Flush volumes will be tested in accordance with ASME A112.19.2 and ASME A112.19.14.

Table 5.303.6 *(Duplicated from 2010 CGBC)* STANDARDS FOR PLUMBING FIXTURES AND FIXTURE FITTINGS	
REQUIRED STANDARDS	
Water closets (toilets) – flushometer valve-type single flush, maximum flush volume	ASME A 112.19.2/CSA B45.1 – 1.28 gal (4.8 L)
Water closets (toilets) – flushometer valve-type dual flush, maximum flush volume	ASME A 112.19.14 and U.S. EPA WaterSense Tank-Type High Efficiency Toilet Specification – 1.28 gal (4.8 L)
Water closets (toilets) – tank type	U.S. EPA WaterSense Tank – Type High-Efficiency Toilet Specification
Urinals, maximum flush volume	ASME A 112.19.2/CSA B45.1 – 0.5 gal (1.9 L)
Urinals, nonwater urinals	ASME A 112.19.19 (vitreous china) ANSI Z124.9-2004 or IAPMO Z124.9 (plastic)
Public lavatory faucets: Maximum flow rate – 0.5 gpm (1.9 L)	ASME A 112.18.1/CSA B125.1
Public metering self-closing faucets: Maximum water use – 0.25 (1.0 L) per metering cycle	ASME A 112.18.1/CSA B125.1
Residential bathroom lavatory sink faucets: Maximum flow rate – 1.5 gpm (5.7 L/min)	ASME A 112.18.1/CSA B125.1

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WORKSHEET (WS-1) (Duplicated from 2010 CGBC) BASELINE WATER USE									
FIXTURE TYPE	FLOW RATE (gpm)[2]		DURATION		DAILY USES		OCCUPANTS[3,4]		GALLONS PER DAY
Showerheads	2.5	X	5 min.	1	1	X		=	
Showerheads residential	2.5	X	8 min.	X	1	X		=	
Lavatory faucets residential	2.2	X	.25 min.	X	3	X		=	
Lavatory faucets nonresidential	0.5	X	.25		3	X		=	
Kitchen faucets	2.2	X	4 min.	X	1	X		=	
Replacement aerators	2.2	X		X		X		=	
Wash fountains	2.2	X		X		X		=	
Metering faucets	0.25	X	.25 min.	X	3	X		=	
Metering faucets for wash fountains	2.2	X	.25 min.	X		X		=	
Gravity tank type water closets	1.6	C	1 flush	X	1 male[1] 3 female	X		=	
Flushometer tank water closets	1.6	X	1 flush	X	1 male[1] 3 female	X		=	
Flushometer valve water closets	1.6	X	1 flush	X	1 male[1] 3 female	X		=	
Electromechanical hydraulic water closets	1.6	X	1 flush	X	1 male[1] 3 female	X		=	
Urinals	1.0	X	1 flush	X	2 male	X		=	
Total daily baseline water use (BWU)								=	
_____(BWU) x .8 = _____Allowable water use									

1. The daily use number shall be increased to three if urinals are not installed in the room.
2. The flow rate is from the CEC Appliance Efficiency Standards, Title 20 California Code of Regulations; where a conflict occurs, the CEC standards shall apply.
3. For low-rise residential occupancies, the number of occupants shall be based on two persons for the first bedroom, plus one additional person for each additional bedroom.
4. For nonresidential occupancies, refer to Table A, Chapter 4, 2010 California Plumbing Code, for occupant load factors

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WORKSHEET (WS-2) (Duplicated form 2010 CGBC) 20 Percent Reduction Water Use									
20 Percent Reduction Water Use Calculation Table									
FIXTURE TYPE	FLOW RATE (gpm)[2]		DURATION		DAILY USES		OCCUPANTS[3,4]		GALLONS PER DAY
Showerheads		X	5 min.	X	1	X		=	
Showerheads residential		X	8 min.	X	1	X		=	
Lavatory faucets residential		X	.25 min.	X	3	X		=	
Lavatory faucets nonresidential		X	.25		3	X		=	
Kitchen faucets		X	4 min.	X	1	X		=	
Replacement aerators		X		X		X		=	
Wash fountains		X		X		X		=	
Metering faucets		X	.25 min.	X	3	X		=	
Metering faucets for wash fountains		X	.25 min.	X		X		=	
Gravity tank type water closets		C	1 flush	X	1 male[1] 3 female	X		=	
HET[5] High-efficiency toilet	1.28	X	1 flush	X	1 male[1] 3 female	X		=	
Flushometer tank water closets		X	1 flush	X	1 male[1] 3 female	X		=	
Flushometer valve water closets		X	1 flush	X	1 male[1] 3 female	X		=	
Electromechanical hydraulic water closets		X	1 flush	X	1 male[1] 3 female	X		=	
Urinals		X	1 flush	X	2 male	X		=	

Urinals Nonwater supplied	0.0	X	1 FLUSH	X	2 MALE	X		=	
Proposed water use								=	
_____(BWU from WS-1) x .8 = _____Allowable water use									

1. The daily use number shall be increased to three if urinals are not installed in the room.
2. The flow rate is from the CEC Appliance Efficiency Standards, Title 20 California Code of Regulations; where a conflict occurs, the CEC standards shall apply.
3. For low-rise residential occupancies, the number of occupants shall be based on two persons for the first bedroom, plus one additional person for each additional bedroom.
4. For nonresidential occupancies, refer to Table A, Chapter 4, 2010 California Plumbing Code, for occupant load factors.
5. Includes single and dual flush water closets with an effective flush of 1.28 gallons or less.
Single flush toilets – The effective flush volume shall not exceed 1.28 gallons (4.8 liters). The effective flush volume is the average flush volume when tested in accordance with ASME A 112.19.233.2
Dual flush toilets - The effective flush volume shall not exceed 1.28 gallons (4.8 liters). The effective flush volume is defined as the composite, average flush volume of two reduced flushes and one full flush. Flush volumes will be tested in accordance with ASME A 112.19.2 and ASME A 112.19.14.

5.303.2.1 Multiple showerheads serving one shower Controlled by a single valve

CALGreen Section: 5.303.2.1 Multiple showerheads serving one shower. When a shower is served by more than one showerhead, the combined flow rate of all the showerheads controlled by a single valve shall not exceed the maximum flow rate at ≥20 percent reduction contained in Table 5.303.2.2 or the shower shall be designed to only allow one showerhead to be in operation at a time.

Exception: The maximum flow rate for shower heads when using the performance method specified in Section 5.303.2.1, Item 2 is 2.5 gpm @ 80 psi.

Intent:
The intent of this code provision is to establish that the maximum flow rate in the 20 percent reduction table covers all applications where water sprays from multiple sources at one time.
It is not the intent to permit multiple independent water supply lines to a single shower enclosure. This is intended to cover a single shower enclosure or space. In multiple shower spaces or gang showers, the requirement shall apply to each shower.

Change for 2012: CBSC is proposing the modification of these sections and tables in response to comments from CARB and to coordinate language with HCD. The primary modification is to indicate that only those showerheads controlled by a single valve must comply. Though it is stated above that it is not the intent to encourage multiple supply lines, they are not prohibited by this section.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision.

Compliance Method:
Specify the shower fixture and fittings to either:
1. Restrict the flow at the valve that serves all the showerheads to provide no more than 2 gpm @ 80 psi as specified in the 20 percent reduction column contained in Table 5.303.2.3;
2. Specify a valve that is designed to allow only one showerhead to be in operation at a time with a maximum flow rate of 2 gpm @ 80 psi; or
3. Performance Method: Refer to Table 5.303.2.2 and provide a calculation demonstrating a 20 percent reduction in the building "water use baseline" with a maximum combined flow rate of 2.5 gpm@80 psi for multiple showerheads.

Contractor: Contractor should be able to provide documentation or self-certification form to the inspector.

Suggestion: *Provide a note on the plans that multiple shower heads controlled by a single valve shall have a*

combined flow rate of all the showerheads not to exceed the maximum flow rates specified in the 20 percent reduction column contained in Table 5.303.2.3. Or note that shower heads are being controlled to work independently. When using the Exception, provide a plumbing calculation on the plans.

Sample worksheets are included in Chapter 8 of the code and Part 4 of this Guide.

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the plans and confirm that multiple shower heads specified meet the combined flow rates on the tables or that they are plumbed to operate independently or that the performance method does not exceed the combined maximum flow rates.

On-Site Enforcement: The inspector should review the permit set of plans to verify that the specified showerheads and/or water reducing fittings are installed. If the performance method was used, the inspector will confirm that showerheads or systems used to reduce overall water use by 20 percent have been installed. The inspector may review fixture specifications provided by the manufacturers as verification of compliance. Testing of flow rates may be done at the inspector's discretion.

DIVISION 5.4 MATERIAL CONSERVATION AND RESOURCE EFFICIENCY

Material Conservation and Resource Efficiency

Weather Resistance and Moisture Management **Changes**

Design for moisture control	
Entries and openings	Exterior door protection: removed notes and updated requirements

Construction Waste Reduction, Disposal and Recycling **Changes**

Construction waste reduction of 50%	Added demolition requirement
Waste management plan requirements	Added demolition requirement
Exception for isolated jobsites	Removed exception

SECTION 5.407 - CONSTRUCTION WASTE MANAGEMENT, DISP0SAL AND RECYCLING

CALGreen Section: 5.407.1 Weather protection. Provide a weather-resistant exterior wall and foundation envelope as required by California Building Code Section 1403.2 (Weather Protection) and California Energy Code Section 150, (Mandatory Features and Devices), manufacturer's installation instructions, or local ordinance, whichever is more stringent.

Intent:
The intent of this code provision is to provide a weather-resistant exterior wall and foundation envelope as currently required by California Building Codes. This measure is to spotlight those existing code provisions and increase the integrity and longevity of the structure.

Existing Law or Regulation:
Currently this code provision is regulated by California Building Code Section 1403.2 (Weather Protection) and California Energy Code Section 150, (Mandatory Features and Devices for low-rise residential) and some local ordinances.

Compliance Method:
Design Team: Determine local conditions that may affect the amount of moisture that might penetrate the envelope due to weather, wind-driven rain or exposure to salt spray, etc. For example, the protection measures in Section 150 of the energy code are required for Climate Zones 14 & 16, in the mountains. Design and detail exterior wall systems to reflect local findings, specifying appropriate materials and vapor retardance. Show on the plans and specifications.

Suggestion: *Pay particular attention to openings and changes of material in detailing exterior wall systems.*
Contractor: Install any exterior wall system in accordance with architectural details and manufacturer's installation instructions.

Suggestion: *Systems like exterior insulation and finish systems, if not installed to manufacturer's installation instructions, have the potential for moisture penetration and condensation that may lead to mold, structural failure, and increased liability.*

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the construction documents to confirm that the exterior wall and foundation envelope meets the California Building Code Section 1403.2 (Weather Protection)

and California Energy Code Section 150, (Mandatory Features and Devices for low-rise residential) and/or local ordinances are being met.

On-Site Enforcement: The inspector should review the permit set of plans to verify that the exterior wall and foundation envelope as specified on the approved plans and specifications are installed.

SECTION 5.713 – MATERIAL CONSERVATION AND RESOURCE EFFICIENCY

CALGreen Section: 5.713.7.1 Weather protection. Provide a weather-resistant exterior wall and foundation envelope as required by California Building Code Section 1403.2 (Weather Protection) and California Energy Code Section 150, (Mandatory Features and Devices), manufacturer's installation instructions, or local ordinance, whichever is more stringent.

Intent:
CBSC adopted this section from the new construction section to provide clarity to the code user requiring weather protection to additions and alterations, preventing damage to the structure and mold contamination. The section refers to regulations already in place.

Compliance and Enforcement: See **§ 5.407.1** of this guide

CALGreen Section: **5.407.2 Moisture control.** Employ moisture control measures by the following methods.
5.407.2.1 Sprinklers. Design and maintain landscape irrigation systems to prevent spray on structures.
5.407.2.2 Entries and openings. Design exterior entries and/or openings subject to foot traffic or wind-driven rain to prevent water intrusion into buildings.
Notes:
1. Use features such as overhangs and recesses, and flashings integrated with a drainage plane.
2. Use non-absorbent floor and wall finishes within at least two feet around and perpendicular to such openings.

Intent:
The intent of this code provision is to minimize the amount of moisture entering the building; at the exterior entries & openings from wind-driven rain and at exterior walls from poorly designed sprinkler systems.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision.

Compliance Method:
For Sprinklers: Design irrigation systems to prevent spray on structures by specifying sprinkler heads which are adjacent to or near exterior walls to have a maximum degree head rotation or spray pattern that ensures protection of the building exterior.

For entries and openings:
1. Use design features such as overhangs and recesses, and flashings integrated with a drainage plane.
2. Specify non-absorbent flooring material at the interior landing surface a minimum of two feet in the direction of travel and at wall finishes adjacent to the door opening on the sides and at the top. If two feet is not available above the opening, wall finishes may terminate at the ceiling.

Suggestion: *Show on the plans (Landscaping Plan, Site plan and Floor plans,) and specifications the sprinkler design and design features that meet the requirements.*

Diagrams in development.

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that the sprinkler design and design features at entries and openings are included in the submitted plans.

On-Site Enforcement: The inspector should review the permit set of plans to verify that the sprinkler design and design features at entries and openings as specified on the approved plans and specifications are installed per specifications.

CALGreen Section: 5.713.7.2. Moisture control. Employ moisture control measures by the following methods.
5.713.7.2.1 Sprinklers. Design and maintain landscape irrigation systems to prevent spray on structures.
5.713.7.2.2 Entries and openings. Design exterior entries and/or openings subject to foot traffic or wind-driven rain to prevent water intrusion into buildings.
Notes:
1. Use features such as overhangs and recesses, and flashings integrated with a drainage plane.
2. Use non-absorbent floor and wall finishes within at least two feet around and perpendicular to such openings.

Intent:
CBSC adopted these sections from the new construction section to provide clarity to the code user requiring moisture control as it applies to additions and alterations, preventing mold contamination and damage to the structure and interior finishes.

Compliance and Enforcement: See **§ 5.407.2** and subsections of this guide

SUBSECTION 5.713.8 CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING

CALGreen Section: 5.408. 1 Construction waste management. Recycle and/or salvage for reuse a minimum **of 50 percent** of the non-hazardous construction waste in accordance with Section 5.408.1.1, 5.408.1.2 or 5.408.1.3; or meet a local construction and demolition waste management ordinance, whichever is more stringent.

5.408.1.1 Construction waste management plan. Where a local jurisdiction does not have a construction and demolition waste management ordinance that is more stringent, submit a construction waste management plan that:

1. Identifies the construction waste materials to be diverted from disposal by efficient usage, recycling, reuse on the project, or salvage for future use or sale.
2. Determines if construction waste materials will be sorted on-site (source-separated) or bulk mixed (single stream).
3. Identifies diversion facilities where construction waste material collected will be taken.
4. Specifies that the amount of construction waste materials diverted shall be calculated by weight or volume, but not by both.

5.408.1.2 Waste management company. Utilize a waste management company that can provide verifiable documentation that the percentage of construction waste material diverted from the landfill complies with this section.

Note: The owner or contractor shall make the determination if the construction waste material will be diverted by a waste management company.

Exceptions to 5.408.1.1 and 5.408.1.2:

1. Excavated soil and land-clearing debris
2. Alternate waste reduction methods developed by working with local agencies if diversion or recycle facilities capable of compliance with this item do not exist.
3. Demolition waste meeting local ordinance or calculated in consideration of local recycling facilities and markets, where demolition of an existing structure(s) is necessary for the

construction of a new structure.

5.408.1.3 Waste stream reduction alternative. The combined weight of new construction disposal that does not exceed 2 lbs/s.f. of building area may be deemed to meet the 50% minimum requirement as approved by the enforcing agency.

5.408.1.4 Documentation. Documentation shall be provided to the enforcing agency which demonstrates compliance with Section 5.408.1.1 through 5.408.1.3. The waste management plan shall be updated as necessary and shall be accessible during construction for examination by the enforcing agency.

Notes:

1. Sample forms found in "A Guide to the California Green Building Standards Code (Nonresidential)" located at: http://www.bsc.ca.gov/CALGreen/default.htm may be used to assist in documenting compliance with the waste management plan.
2. Mixed construction and demolition debris (C&D) processors can be located at the California Department of Resources Recycling and Recovery (CalRecycle).

5.408.2 Isolated jobsites. The enforcing agency may make exceptions to the requirements of this section when jobsites are located in areas beyond the haul boundaries of the diversion facility.

Intent:
Since construction waste makes up about 27% of the waste stream in California, this code provision is reducing the amount of construction waste from new construction that would be sent to the landfills, thereby extending the life of the landfills. Its purpose is also to encourage material resource efficiency through re-use and recycling of construction waste products.

Change for 2012: CBSC is proposing combining three sections into one, **5.408.1 Construction waste management**, to provide clarity to the code user. Terms are being coordinated to mean the same things. Options for utilization of an approved waste management company and a waste stream reduction alternative for efficient construction methods are added to provide more methods of compliance. Exceptions are broadened to recognize that 50% of demolition waste may not be recyclable locally.

Existing Law or Regulation:
AB 939 (Stats. 1989, c. 1095) mandated a 50% diversion of all waste by 2000, but the CALGreen regulation targets 50% of new construction waste that makes up a smaller percentage of the total waste stream. There are some local jurisdictions that have ordinances in place that have requirements for this provision.

Compliance Method:
1. Determine if a local construction waste management ordinance is in place in your jurisdiction and comply with the more stringent requirement
2. Determine what local hauling and recycling facilities are available in your area to establish the most economically feasible option for recycle and/or salvage of construction debris. If there is no facilities in your area, use Exception 2 and work with the local enforcing agency to establish an acceptable alternate.
3. If applicable to the project, e.g., where walls are framed off-site or panelized wall systems are employed that reduce site waste significantly, the waste stream alternative may be appropriate. Document the weight

of total waste compared to the building area, which may considered the gross square footage of each floor and the roof as approved by the enforcing agency.

4. Include for recycling the following materials: carpet, wood, aggregate, paint, shingles, wallboard or any other materials that have recyclable value. For more information on various materials visit the C&D Publications link on the CALRecycle website, the Construction Waste Management (CWM) Worksheet provided in Part 4 of this Guide, or as required by local ordinance.

Note: *The demolition debris provision may be applicable in the CALGreen code if an EXISTING building is going to be completely torn down and a NEW building built on the same site, where both are considered to be part of the same project. This would be determined on a case by case basis. Local market conditions may determine the level of diversion of demolition debris acceptable to the local enforcing agency.*

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the plans, specifications and/or forms to confirm that a construction waste management plan has been included with the plan submittal or that and Exception 2 has been approved by the enforcing agency.

On-Site Enforcement: The inspector should review the approved construction waste management plan or Exception 2 to verify that the plan is being followed or that an exception is being used. The inspector may ask for haul tags and/or reports from the contractor to verify compliance with the 50 percent waste reduction. Verification by documentation from a waste management company or recycling facility is acceptable.

Suggestion: *Building departments are strongly urged to work with their jurisdictions' Recycling Coordinators to determine if local conditions warrant exemptions and to identify appropriate means of alternate compliance.*

CALGreen Section: 5.713.8.1 Construction waste management. For additions and remodels recycle and/or salvage for reuse a minimum of 50 percent of the non-hazardous construction waste in accordance with Section 5.713.8.1.1 or 5.713.8.1.2; or meet a local construction and demolition waste management ordinance, whichever is more stringent.

[The provision in Division 5.4 for a waste stream alternative is eliminated from this subsection, with the balance of subsections unchanged from those in Division 5.4]

Intent:
The intent of this measure is to ensure that construction waste is diverted away from landfills and re-used or recycled at a rate of at least 50% of total construction waster, either in conformance
with local ordinance, a construction Waste Management Plan (WMP) or utilization of a waste management company certifying to a 50% diversion.

Change for 2012: CBSC adopted this section and subsections as modified for the new construction division, to provide clarity to the code user. The pounds-per-square-foot alternative is not included here, because more demolition waste is expected with additions or alterations than with new construction; however, there is more potential for reuse of materials. Other than that, this proposal recognizes that waste generated from additions and alterations should be recycled at the same rate as for new construction. The exception for demolition debris is maintained for those circumstances where, due to local facilities and markets, demolition may be recycled at other than a 50% rate.

Compliance and Enforcement: See **§ 5.408.1** and subsections of this guide

CALGreen Section: 5.408.3 Excavated soil and land clearing debris. 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled. For a phased project, such material may be stockpiled on site until the storage site is developed.

Exception: Reuse, either on-or off-site, of vegetation or soil contaminated by disease or pest infestation.

Notes:

1. If contamination by disease or pest infestation is suspected, contact the County Agricultural Commissioner and follow its direction for recycling or disposal of the material. (www.cdfa.ca.gov/exec/county/county_contacts.html)
2. For a map of known pest and/or disease quarantine zones, consult with the California Department of Food and Agriculture (www.cdfa.ca.gov)

Intent:
The intent of this code provision is to reduce the high volume, bulky land clearing materials from filling up the landfills and to encourage the market for non-hazardous land clearing debris. It is not meant to apply to clearing of contaminated sites for purposes such as brownfield remediation.

Change for 2012: In response to comment from the building industry, CBSC is proposing to add an exception to exempt certifiably diseased soil and land clearing debris from being reused. This section is also being renumbered to 5.408.3 to coordinate with the format of the previous section and subsections.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision. However, there are some local jurisdictions that have ordinances in place that have requirements for this provision.

Compliance Method:

1. Determine if a local construction ordinance is in place in your jurisdiction and comply with the more stringent requirement or as accepted by the local enforcing agency.

2. Look for local markets and salvage opportunity for re-use of clearing debris.
3. For phased developments and other long term projects, the materials may be stored on site until project completion.

Suggestion: *The need to salvage or recycle land clearing debris can be reduced by site planning that maintains such features as trees and rocks in the project where feasible.*

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and look for the appropriate note on the plans (civil plan), WMP or CWM Worksheet that describes the method of disposal of land clearing debris.

On-Site Enforcement: The inspector should review the permit set of plans and will verify that the excavated soil and land clearing debris is being reused or recycled as specified on the plans.

CALGreen Section: 5.713.8.3 Excavated soil and land clearing debris. 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled. For a phased project, such material may be stockpiled on site until the storage site is developed.

Exception: Reuse, either on-or off-site, of vegetation or soil contaminated by disease or pest infestation.

Notes:
3. If contamination by disease or pest infestation is suspected, contact the County Agricultural Commissioner and follow its direction for recycling or disposal of the material. (www.cdfa.ca.gov/exec/county/county_contacts.html)
4. For a map of known pest and/or disease quarantine zones, consult with the California Department of Food and Agriculture (www.cdfa.ca.gov)

Intent:
The intent of this code provision is in the event of land clearing for an addition or a renovation, CBSC adopted this section, including an exception to exempt certifiably diseased soil and land clearing debris from being reused, as for new construction.

Compliance and Enforcement: See **§ 5.408.4.3** of this guide

Building Maintenance and Operation	Changes
Recycling by occupants	Added clarification for ordinance requirements
	New Section: Clarifies requirements
Building commissioning for new buildings 10,000 square feet and over	Clarifies requirements for new construction only
	Note: All energy related requirements for Commissioning, OPR & BOD now have a reference to the Energy Code
Testing and adjusting for buildings less than 10,000 square feet	New Section: Clarifies requirements for new buildings or new systems to serve additions or alterations
Temporary construction ventilation	Clarifies requirements for areas of additions or alterations

Finish materials	Changes
Carpet systems	Clarifies VOC emissions limits and testing
requirements	
	Added CA-CHPS to list of approved methods of compliance
Composite wood products	Clarifies the formaldehyde limits in a revised table
Resilient flooring	Clarifies VOC emissions limits and testing
	Added CA-CHPS to list of approved methods of
compliance	
Filters requirements for small H.E. ductless units	Clarifies MERV exceptions and added new exception for existing mechanical equipment
	New section: Labeling requirements

Indoor air quality	Changes
CO2 monitoring	Clarifies that it also applies to additions
Environmental comfort	
Exterior noise transmission	Clarifies applications to additions or altered envelope

Outdoor air quality	Changes
	New Sections:
	Supermarket refrigerant leakage reduction: for retail food stores 8,000 square foot or more
	Refrigerant piping: meet California Mechanical Code
	Values: meet California Mechanical Code
	Refrigerated services cases: use corrosion-resistant materials
	Refrigerant receivers: if over 200 lbs, provide level indicator
	Pressure testing: test during installation
	Evacuation: evacuate after pressure testing and prior to charging

SUBECTION 5.713.10 – BUILDING MAINTENANCE AND OPERATION

CALGreen Section: 5.410.1 Recycling by occupants. Provide readily accessible areas that serve the entire building and are identified for the depositing, storage, and collection of non- hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics and metals.

5.410.1.1 Sample ordinance. Space allocation for recycling areas shall comply with Chapter 18, Part 3, Division 30 of the Public Resources Code. Chapter 18 is known as the California Solid Waste Reuse and Recycling Access Act of 1991 (Act).

Note: A sample ordinance for use by local agencies may be found in Appendix A of the document at the Cal Recycle's web site.

Intent:

The intent of this code provision is to direct attention to existing law to provide areas for recycling by occupants, including collection and loading of recyclable materials.

Existing Law or Regulation:

Currently there is a requirement for a model ordinance in Chapter 18, Part 3, Division 30 of the Public Resources Code. Chapter 18 is known as the California Solid Waste Reuse and Recycling Access Act of 1991 (Act) that can be used for statewide application.

Compliance Method:

1. Determine if a local recycling ordinance is in place in your jurisdiction and comply. If no ordinance; then use the model recycling ordinance.
2. Show on the plans (site and/or floor plans) readily accessible areas and signage for those areas that serve the entire building for recycling of non-hazardous materials by occupants.
3. In accordance with the model ordinance, recycling areas shall be secure; be protected from the elements, such as rain; and be adequately separated from occupied spaces for protection against impacts such as noise, odor and pests.
4. Where feasible, recycling areas should be located adjacent to solid waste collection areas.

Note: *A sample ordinance for use by local agencies may be found in Appendix A of the document at the*

CalRecycle web site.

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and confirm that the appropriate recycling areas and signage for those areas have been provided on the plans.

On-Site Enforcement: The inspector should review the permit set of plans to verify that the recycling areas and signage for those areas on the plans and specifications are installed

CALGreen Section: 5.713.10.1 Recycling by occupants. If not provided on the existing site and where site conditions permit, provide readily accessible areas that serve the entire building and are identified for the depositing, storage, and collection of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics and metals in accordance with one of the following:

1. **For additions or alterations by on owner or a tenant conducted within a 12-month period under single or multiple permits resulting in an increase of 30% or more in floor area**
2. **For additions or alterations by an owner or a tenant for which multiple permits are applied within a 12-month period resulting in an increase of 30% or more in floor area**
3. As required by a lawfully enacted local recycling ordinance, if more restrictive.

[Balance of subsections are identical to those in Division 5.4]

Intent:
CBSC adopted and amended this section from the new construction division to provide clarity to the code user regarding the establishment of recycling areas for occupants, if not provided on
site, in the event of an addition or alteration. It clarifies its application only to certain additions and alterations. This conforms to the California Solid Waste Reuse and Recycling Access Act of 1991.

Compliance and Enforcement: See **§ 5.410.1 & § 5.410.1.1** of this guide

5. Functional performance testing

CALGreen Section: 5.410.2.4 Functional performance testing. Functional performance tests shall demonstrate the correct installation and operation of each component, system, and system-to-system interface in accordance with the approved plans and specifications. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.

Intent:
Develop and implement the functional performance tests to document, as set forth in the Commissioning Plan that all components, equipment, systems and system-to-system interfaces were installed as specified, and operate according to the Owner's Project Requirements, Basis of Design, and plans and specifications.

The following systems to be functionally tested are listed in the Basis of Design (5.410.2.2 of the Code):

1. Heating, Ventilation, Air Conditioning (HVAC) Systems and Controls
2. Indoor Lighting System and Controls
3. Water Heating System
4. Renewable Energy Systems
5. Landscape Irrigation Systems
6. Water Reuse Systems

Existing Law or Regulation:
Title 24 Acceptance Testing requirements call for functional testing of some systems and equipment required to be commissioned by CALGreen. Refer to Title 24 and Nonresidential Compliance Manual For California's 2008 Energy Efficiency Standards.
http://www.energy.ca.gov/title24/2008standards/nonresidential_manual.html

Note: CALGreen Functional Performance Tests are not intended to replace the Title 24 Section 6 Acceptance Tests. Instead, the T24 acceptance tests, which focus on energy efficiency, can be

part of the broader scope of testing forms and procedures required for CALGreen compliance.

Review local ordinances for any applicable requirements.

Compliance Method:
Compliance is demonstrated by developing and implementing test procedures for each piece of commissioned equipment and interfaces between equipment and systems according to the building-specific Commissioning Plan. Tests should include verification of proper operation of all equipment features, each part of the sequence of operation, overrides, lockouts, safeties, alarms, occupied and unoccupied modes, loss of normal power, exercising a shutdown, startup, low load through full load (as much as is possible) and back, staging and standby functions, scheduling, energy efficiency strategies and loop tuning.

Elements of acceptable test procedures include:
1. *Date and Party* -- Identification of the date of the test and the party conducting the test.
2. *Signature Block* **--** Signature of the designated commissioning lead and the equipment installing contractor attesting that the recorded test results are accurate.
3. *Prerequisites* -- Any conditions or related equipment checkout or testing that needs to be completed before conducting this test.
4. *Precautions* -- Identification of the risks involved to the test team members and the equipment and how to mitigate them.
5. *Instrumentation* **--** Listing of the instrumentation and tools necessary to complete the test.
6. *Reference* – In each procedure item, identify the source for what is being confirmed (e.g., sequence of operation ID, operating feature, specification requirement, etc.).
7. *Test Instructions* **--** Step-by-step instructions of how to complete the test, including functions to test and the conditions under which the tests should performed.
8. *Acceptance Criteria* **--** Measurable pass / fail criteria for each step of the test, as applicable.
9. *Results* **--** Expected system response and space to document the actual response, readings, results and adjustments.
10. *Return to Normal* **--** Instructions that all systems and equipment are to be returned to their as-found state at the conclusion of the tests.
11. *Deficiencies* -- A list of deficiencies and how they were mitigated.

See (Part 4) for forms and templates.

Enforcement:

At their discretion, the building official confirms demonstrated compliance during *Onsite Enforcement* by:

a)Receipt of a copy of completed and signed Functional Performance Tests and corrected deficiencies, or

b)Receipt of a form signed by the owner, owner representative or commissioning coordinator attesting that the Functional Performance Tests have been completed and any deficiencies corrected.

See (Part 4) for forms and templates.

CALGreen Section: 5.713.10.4 Testing and adjusting. Testing and adjusting of new systems installed to serve an addition or alteration subject to Section 5.701.1 shall be required.

[Balance of subsections are unchanged from those in Division 5.4]

Intent:

These provisions for means of achieving quality control for building systems are being proposed additions and alterations where a new system is installed or an existing one upgraded to serve a new or renovated space. This promotes energy and water savings as systems are installed, tested, and adjusted for maximum efficiency when the project is turned over to the owner. Operation and maintenance information is to be provided to the owner to assist with continued efficiency beyond certificate of occupancy.

Compliance and Enforcement: See **§ 5.410.4** and subsections of this guide

SECTION 5.714 ENVIRONMENTAL QUALITY
DIVISION 5.5 ENVIRONMENTAL QUALITY

SECTION 5.503 – FIREPLACES

CALGreen Section: 5.503.1 General. Install only a direct-vent sealed-combustion gas or sealed wood-burning fireplace, or a sealed woodstove or pellet stove, and refer to residential requirements in the California Energy Code, Title 24, Part 6, Subchapter 7, Section 150. Woodstoves, pellet stoves and fireplaces shall comply with applicable local ordinances.

5.503.1.1 Woodstoves. Woodstoves and pellet stoves shall comply with U.S. EPA Phase II emission limits.

Intent:
Although limited in non-residential applications, this code provision is intended to prevent the use of indoor air for combustion and to prevent contaminated air and any unused fuel from escaping the sealed fireplace to maintain indoor air quality and increased energy efficiency.

Existing Law or Regulation:
Currently the California Energy Code, CCR, Title 24, Part 6, Subchapter 7, Section 150 regulates residential fireplaces. There may be a local or regional ordinance in place.

Compliance Method:
1. Specify and install a direct-vent gas fireplace
2. Specify and install a pellet or wood stove which meets the US EPA Phase II emission standards.
3. Comply with local or regional ordinance.

Suggestion:
Contractor: *Retain product data sheets for onsite verification by the enforcing agency and for the operation and maintenance manual.*

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that the fireplaces and/or woodstoves meet the direct-vent sealed-combustion and/or US

EPA Phase II emission limits.

On-Site Enforcement: The inspector should review the permit set of plans and product data sheets to verify that the fireplaces and/or woodstoves as specified on the approved plans and specifications are installed, or are stored on site with the ability to be verified

SECTION 5.714.3 – FIREPLACES

CALGreen Section: 5.714.3.1 General. Install only a direct-vent sealed-combustion gas or sealed wood-burning fireplace, or a sealed woodstove or pellet stove, and refer to residential requirements in the California Energy Code, Title 24, Part 6, Subchapter 7, Section 150. Woodstoves, pellet stoves and fireplaces shall comply with applicable local ordinances.
5.714.3.1.1 Woodstoves. Woodstoves and pellet stoves shall comply with U.S. EPA Phase II emission limits.

Intent:
CBSC adopted this section from the new construction division to provide clarity to the code user regarding the use of gas and wood burning appliances listed in this section for additions or alterations. As rarely-used amenities in new nonresidential construction, they are not required for heat but are typically installed for effect.

Compliance and Enforcement: See **§ 5.503** of this guide

SECTION 5.504 – POLLUTANT CONTROL

CALGreen Section: 5.504.1.3 Temporary ventilation. The permanent HVAC system shall only be used during construction if necessary to condition the building within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE 52.2 1999, or an average efficiency of 30% based on ASHRAE 52.1 1992. Replace all filters immediately prior to occupancy.

Intent of new section for 2012:
The intent of this new section is for mandatory compliance, taken from voluntary Section A5.504.1.1, Item 3, which allows limited use of the permanent heating and cooling system during construction and requires the use of air filters with a Minimum Efficiency Reporting Value (MERV) of 8. It is intended to control air pollutants for workers during construction and ensure good air quality for occupants when the building is turned over to the owner. It allows ventilation using air conditioning systems if necessary, though this practice is noted not to be an optimum choice due to possible damage to equipment that may jeopardize a warranty.

Existing Law or Regulation:
The California Energy Code, CCR, Part 6 contains ventilation standards for conditioned spaces. CCR, Title 8 contains additional regulations for the protection of worker safety.

Compliance Method:
Engineers and designers should include the measures intended to promote air quality in the project specifications for ventilation, materials and others as applicable. The contractor should be responsible for employing them on the job and being able to demonstrate that the practices are being followed if requested by the enforcing agency.

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications for directions on ventilation practices to be followed by the contractor.

On-Site Enforcement: The inspector should review the permit set of plans to verify which air quality practices the contractor is to use on the project and ask for demonstration of their employment during site visits.

CALGreen Section: 5.714.4.1 Temporary ventilation. The permanent HVAC system shall only be used during construction if necessary to condition the building within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE 52.2 1999, or an average efficiency of 30% based on ASHRAE 52.1 1992. Replace all filters immediately prior to occupancy.

Intent:

This new section for mandatory compliance for newly constructed buildings, taken from Section A5.504.1.1, Item 3, allows limited use of the permanent heating and cooling system during construction of additions and areas of alteration. It requires the use of air filters with a Minimum Efficiency Reporting Value (MERV) of 8 and is intended to control air pollutants for workers during construction and ensure good air quality for occupants.

Compliance and Enforcement: See **§ 5.504.1.3** of this guide

CALGreen Section: 5.504.3 Covering of duct openings and protection of mechanical equipment during construction. At the time of rough installation and during storage on the construction site until final startup of the heating, cooling and ventilating equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheetmetal or other methods acceptable to the enforcing agency to reduce the amount of dust, water and debris which may enter the system.

Intent:
To enhance HVAC equipment efficiency and indoor air quality at building occupancy by preventing construction debris from building up in the air ducts during construction.

Change for 2012: CBSC is proposing to modify this section in concert with HCD, in response to comments made by CARB, to clarify for the code user when protection is needed, which equipment to protect, and against what pollutants ducts should be sealed.

Existing Law or Regulation:
The California Energy Code, CCR, Part 6 contains ventilation standards for conditioned spaces. CCR, Title 8 contains additional regulations for the protection of worker safety.

Compliance Method:
Engineers and designers should include the measures intended to promote air quality in the project specifications for ventilation, materials and others as applicable. The contractor should be responsible for employing them on the job and being able to demonstrate that the practices are being followed if requested by the enforcing agency.

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications for directions on ventilation practices to be followed by the contractor.

On-Site Enforcement: The inspector should review the permit set of plans to verify which air quality practices the contractor is to use on the project and ask for demonstration of their employment during site visits.

CALGreen Section: 5.714.4.3 Covering of duct openings and protection of mechanical equipment during construction. At the time of rough installation and during storage on the construction site until final startup of the heating, cooling and ventilating equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal or other methods acceptable to the enforcing agency to reduce the amount of dust, water and debris which may enter the system.

Intent:
To enhance HVAC equipment efficiency and indoor air quality at building occupancy by preventing construction debris from building up in the air ducts during construction. CBSC adopted this section for applicable additions and alterations as modified for new construction. The purpose is to protect building occupants from indoor pollution from HVAC equipment operation and to protect the equipment against damage.

Compliance and Enforcement: See **§ 5.504.3** of this guide

SECTION 5.714.4.4 – ENVIRONMENTAL QUALITY

CALGreen Section: 5.504.4 Finish material pollutant control. Finish materials shall comply with Sections 5.504.4.1 through 5.504.4.4.

5.504.4.1 Adhesives, sealants, and caulks. Adhesives, sealants, and caulks used on the project shall meet the requirements of the following standards:

1. Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene, and trichloroethylene), except for aerosol products as specified in subsection 2, below.

2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of California Code of Regulations, Title 17, commencing with Section 94507.

Tables not shown – refer to Code

5.504.4.3 Paints and coatings. Architectural paints and coatings shall comply with VOC limits in Table 1 of the ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3, unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed in Table 5.504.4.3, shall be determined by classifying the coating as a Flat, Nonflat, or Nonflat-High Gloss coating, based on its gloss, as defined in subsections 4.21, 4.36, and 4.37 of the 2007 California Air Resources Board Suggested Control Measure, and the corresponding Flat, Nonflat, or Nonflat- High Gloss VOC limit in Table 5.504.4.3 shall apply.

5.504.4.4 Carpet systems. All carpet installed in the building interior shall meet the testing and product requirements of one of the following:

1. Carpet and Rug Institute's Green Label Plus Program.
2. California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical

Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (also known as Specification 01350).
3. NSF/ANSI 140 at the Gold level or higher.
4. Scientific Certifications Systems Sustainable Choice.

5.504.4.4.1 Carpet cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute's Green Label program.

5.504.4.4.2 Carpet adhesive. All carpet adhesive shall meet the requirements of Table 5.504.4.1.

5.504.4.5 Composite wood products. Hardwood plywood, particleboard, and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in CARB's Air Toxics Control Measure for Composite Wood (17 CCR 93120 et seq.), by or before the dates specified in those sections, as shown in Table 5.504.4.5.

Table not shown – refer to Code

5.504.4.5.1 Early compliance. Reserved.

5.504.4.5.2 Documentation. Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following:

1. Product certifications and specifications
2. Chain of custody certifications standards

standards.
5. Other methods acceptable to the enforcing agency.

5.504.4.6. Resilient flooring systems. For 50 percent of floor area receiving resilient flooring, install resilient flooring complying with the VOC-emission limits defined in the 2009 Collaborative for High Performance Schools (CHPS) criteria and listed on its High Performance Products Database; products compliant with CHPS criteria certified under the Greenguard Children & Schools program; certified under the Resilient Floor Covering Institute (RFCI) FloorScore program; or meet California Department of Public Health 2010 Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (also known as Specification 01350.)

[DSA-SS] Documentation shall be provided that verifies that finish materials are certified to meet the pollutant

Intent:
The purpose of these measures is to reduce the volatile organic compounds (VOC) of finish materials commonly installed on a project, which will help improve air quality for the building occupants.

Change for 2012: Most of the changes proposed for this division resulted from comments received from CARB. They are intended to provide clarity and accuracy for the code user.

Sections 5.504.4.4 Carpet systems and 5.504.4.3.1 Carpet cushion. CBSC has updated the referenced standards as suggested by CARB to their current names. The standard for NSF/ANSI 140 “Gold” is also tagged as a minimum standard, not an absolute, for clarity.

Section 5.504.4.4.2 Documentation [for composite wood products]. This section is modified in response to

comments by CARB to clarify for the code user the qualifying product certifications.

Section 5.504.4.6 Resilient flooring systems. CBSC is proposing updating the referenced standards as suggested by CARB to their current names, including a reference to Greenguard-certified products previously cited in a note.

Existing Law or Regulation:
The low-VOC provisions are based on the recommendations, guidelines and regulations of the Air Resources Board cited in each section. Regulations for aerosol adhesives and paints and for composite wood products are found in California Code of Regulations, Title 17 as noted above.

Compliance Method:
Specify finish materials that meet the limits of VOC shown in the tables for adhesives and sealants, paints and coatings, and composite wood products (particle board and hardboard casework). Flooring products (carpet systems and resilient flooring) shall be specified to meet VOC limit criteria as tested by the listed organizations. Substitutes may be approved by the local enforcing authority if it deems equivalency.

Suggestion:
Contractor: *Retain product data sheets for onsite verification by the enforcing agency and for the operation and maintenance manual. Sample compliance forms can be found in Part 4 of this Guide.*

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that the finishes are specified to meet VOC emission limits.

On-Site Enforcement: The inspector should review the permit set of plans and product data sheets maintained by the contractor to verify finishes specified on the approved plans and specifications are installed, or at least stored on site with the ability to be verified. The inspector may review data on material containers or specifications provided with products or accept self- certification form.

CALGreen Section: 5.714.4.4 Finish material pollutant control.

Finish materials shall comply with Sections 5.714.4.4.1 through 5.714.4.4.6
Public Health 2010 Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (also known as Specification 01350.)

Intent:
The purpose of these measures is to reduce the volatile organic compounds (VOC) of finish materials commonly installed on an addition and alteration project, which will help improve air quality for the building occupants as for new construction in Division 5.5. During rulemaking and
publication, an error was made in the referenced sections. They should read “Sections 5.714.4.4.1 through 5.714.4.4.6, up to and including resilient flooring systems.

Compliance and Enforcement: See **§ 5.504.4.4** through **§ 5.504.4.6** of this guide

CALGreen Section: 5.504.5.3 Filters. In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a Minimum Efficiency Reporting Value (MERV) of 8. MERV 8 filters shall be installed
prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.

Exception: A MERV-1 filter shall be allowed for return air only or return with prefiltered outside air if the filter is of a re-usable, non-disposable type, and the fan energy use of that air delivery system is 0.4W/cfm or less at design airflow.

Intent:
The intent of this regulation is to filter particulate matter from the air by the use of at least MERV 8-rated filters for improved air quality.

Change for 2012: CBSC is proposing modification of this section providing clarity for the code user to emphasize that MERV 8 filters are to be installed prior to occupancy and that their replacement with like filters should be a recommendation for operation of a building. (See also Section 5.504.1.3, above.) Also, in response to comment, an exception has been added for certain ductless HVAC equipment which is incompatible with the MERV 8 filter requirement, but which is highly efficient and provides other benefits to a building operator or occupant.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision.

Compliance Method:
Specify and install prior to occupancy at least MERV 8 filters for the return air grilles.

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that the filters are specified to meet MERV 8, or that specified equipment qualifies for the
exception.

On-Site Enforcement: The inspector should review the permit set of plans and product data sheets maintained by the contractor to verify that HVAC filtration specified on the approved plans and specifications are installed, or are

stored on site with the ability to be verified. The inspector may check a sample of installed filters to verify the MERV rating.

CALGreen Section: 5.714.4.6.1 Filters. In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media for outside and return air that provides at least a Minimum Efficiency Reporting Value (MERV) of 8. MERV 8 filters shall be installed
prior to occupancy, and recommendations for maintenance with filters of the same value shall be included in the operation and maintenance manual.

Exception: A MERV-1 filter shall be allowed for return air only or return with prefiltered outside air if the filter is of a re-usable, non-disposable type, and the fan energy use of that air delivery system is 0.4W/cfm or less at design airflow.

Intent:
The intent of this regulation is to filter particulate matter from the air by the use of at least MERV 8-rated filters for improved air quality.

Change for 2012: CBSC adopted this section and exception as applicable to additions and alterations as modified for new construction to provide clarity for the code user to emphasize that MERV 8 filters are to be installed prior to occupancy and that their replacement with like filters should be a recommendation for operation of a building. It proposes the same exception for highly energy-efficient ductless HVAC equipment.

Compliance and Enforcement: See **§ 5.504.5.3** of this guide

CALGreen Section: **5.504.7 Environmental tobacco smoke (ETS) control.** Where outdoor areas are provided for smoking, prohibit smoking within 25 feet of building entries, outdoor air intakes and operable windows and within the building as already prohibited by other laws or regulations; or as enforced by ordinances, regulations, or policies of any city, county, city and county, California Community College, campus of the California State University, or campus of the University of California, whichever are more stringent. When ordinances, regulations, or policies are not in place, post signage to inform building occupants of the prohibitions.

Intent:
By prohibiting smoking in buildings, and in those instances where outdoor areas are and dedicated for the use of smokers, this provision is intended to improve indoor air quality and to protect non-smokers from second hand smoke.

Change for 2012: CBSC is proposing a minor change in response to comment from CARB to recognize that other laws and regulations may apply to smoking in and around buildings. Smoking is a public health issue that is within the authority of California Department of Public Health, and currently the Labor Code allows smoking in certain workplaces. Building codes are intended to regulate construction and installation of building appurtenances, not building operations or occupant behavior.

Existing Law or Regulation:
State law prohibits smoking inside most buildings, and many local jurisdictions and college campuses have regulations that require a certain distance that smoking can occur outside a building. AB 1807 (Stats. 1983, c. 1047) is the public policy of the state that emissions of toxic air contaminants should be controlled to levels which prevent harm to the public health.

Compliance Method:
Include in the signage specification and post signs that prohibit smoking for an outdoor smoking area within 25 feet of building entries, outdoor air intakes and operable windows where they occur.

Suggestion: *In order to clarify sign placement and smoking area(s), show on one or all of the following plans: Site Plan, Floor Plan, Elevations and/or Detail Sheet.*

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that, if an outdoor smoking area is shown, signage is specified and located.

On-Site Enforcement: The inspector should review the permit set of plans against the outdoor smoking area and verify signage installed in the field.

CALGreen Section: 5.714.4.7 Environmental tobacco smoke (ETS) control. Where outdoor areas are provided for smoking, prohibit smoking within 25 feet of building entries, outdoor air intakes and operable windows and within the building as already prohibited by other laws or regulations; or as enforced by ordinances, regulations, or policies of any city, county, city and county, California Community College, campus of the California State University, or campus of the University of California, whichever are more stringent. When ordinances, regulations, or policies are not in place, post signage to inform building occupants of the prohibitions.

Intent:
By prohibiting smoking in buildings, and in those instances where outdoor areas are and dedicated for the use of smokers, this provision is intended to improve indoor air quality and to protect non-smokers from second hand smoke.

Change for 2012: CBSC has adopted this section where it may apply to an addition or alteration, including a minor amendment for new construction in response to comment from CARB to recognize that other laws and regulations may apply to smoking in and around buildings.

Compliance and Enforcement: See **§ 5.504.7** of this guide

CALGreen Section: 5.505.1 Indoor moisture control. Buildings shall meet or exceed the provisions of California Building Code, CCR, Title 24, Part 2, Sections 1203 (Ventilation) and Chapter 14 (Exterior Walls). For additional measures not applicable to low-rise residential occupancies, see Section 5.407.2 of this code.

Intent:
The intent is to direct the code user to other parts of Title 24 and this part for those provisions that are intended to reduce the probability of mold and mildew growth and improve air quality.

Existing Law or Regulation:
California Building Code Section 1203 for attic spaces and under-floor ventilation, Chapter 14 for a weather-resistant exterior wall envelope, and Section 5.407.2.2 Entries and openings in this code.

Compliance Method:
Design Team: Include details on the construction plans addressing issues of moisture control,

Contractor: Understand and install moisture control according to construction documents and manufacturer's installation recommendations.

Note: *Vapor control recommendations for different climate zones may found at www.buildingscience.com .*

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that moisture control features which meet Title 24 are specified and detailed.

On-Site Enforcement: The inspector should review the permit set of plans and confirm that moisture control measures have been incorporated into the building. Collect a copy of self- certification form if completed and signed by the contractor.

CALGreen Section: 5.714.7.1 Indoor moisture control. Buildings shall meet or exceed the provisions of California Building Code, CCR, Title 24, Part 2, Sections 1203 (Ventilation) and Chapter 14 (Exterior Walls). For additional measures not applicable to low-rise residential occupancies, see Section 5.407.2 of this code.

Intent:
CBSC adopted this section to provide clarity to the code user regarding moisture control. CBSC is proposing to include references to direct the code user to the California Building Code for general ventilation and moisture control requirements, which are intended to protect occupants
from harmful molds and mildews.

Compliance and Enforcement: See **§ 5.505.1** of this guide

SECTION 5.714.6 INDOOR AIR QUALITY

SECTION 5.506 INDOOR AIR QUALITY

CALGreen Section: 5.506.1 Outside air delivery. For mechanically or naturally ventilated spaces in buildings, meet the minimum requirements of Section 121 (Requirements For Ventilation) of the 2010 California Energy Code, or the applicable local code, whichever is more stringent, and Division 1, Chapter 4 of CCR, Title 8.

Intent:
The purpose is to point building designers and contractors to the ventilation requirements in the California Code of Regulations that are intended to improve indoor air quality for building occupants.

Existing Law or Regulation:
The California Energy Code, CCR, Title 24, Part 6, Sections 121(a) through 121(e) with flow rates as required by Table121-A. There is a possibility of a more stringent local ordinance.

Compliance Method:
Most engineers and contactors are familiar with following the provisions of the energy code that specify requirements for naturally and mechanically ventilated spaces, and may comply with this provision by using energy code compliance tools currently in place. Title 8 for Cal OSHA may have additional regulations which emphasize air quality for workers in particular environments which should be followed as required.

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans and specifications to confirm that building ventilation is calculated and specified to Title 24, Part 6, and if applicable, Part 8.

On-Site Enforcement: The inspector should review the permit set of plans against the natural ventilation features and mechanical ventilation systems that are installed on the project, requesting results of any testing of ventilation rates. Adequate pre-occupancy building ventilation shall be verified.

CALGreen Section: 5. 714.7.2 Outside air delivery. For mechanically or naturally ventilated spaces in buildings, meet the minimum requirements of Section 121 (Requirements For Ventilation) of the 2010 California

Energy Code, or the applicable local code, whichever is more stringent, and Division 1, Chapter 4 of CCR, Title 8.

Intent:
CBSC adopted this section to provide clarity to the code user regarding the mechanical or natural delivery of outdoor air to additions or areas of alteration, including references to direct the code user to the California Energy Code, Title 24, Part 6 and Title 8, Chapter 4 for requirements.

Compliance and Enforcement: See **§ 5.506.1** of this guide

CALGreen Section: 5.506.2 Carbon dioxide (CO_2) monitoring. For buildings equipped with demand control ventilation, CO_2 sensors and ventilation controls shall be specified and installed in accordance with the requirements of 2010 California Energy Code, Section 121(c).

Intent:

When demand control ventilation is required by Part 6, this provision intends to maintain CO^2 levels which are within the range that is safe for human occupation.

Existing Law or Regulation:

The current edition of the California Energy Code, CCR, Title 24, Part 6, Section 121(c) identifies the sensors, controls and devices required to keep CO^2 emissions at safe levels.

Compliance Method:

Design Team: The designer should specify and show calculations and locations for CO^2 sensors in the construction documents. The team familiar with demand control ventilation will be familiar with these requirements.

Contractor: The contractor should install the specified equipment and make sure that it is operating as designed. Again, familiarity with demand control ventilation will be an advantage.

Suggestion:

Contractor: *Retain product data sheets for onsite verification by the enforcing agency and for the operation and maintenance manual.*

Enforcement:

Plan Intake: The reviewer and/or plan checker should review the plans, specifications and calculations to confirm that sensors are included which meet the requirements of Part 6.

On-Site Enforcement: The inspector should review the permit set of plans and product data sheets to verify that complying sensors displaying readings are installed in designated locations. He/she should obtain assurance that the readings are

recorded as required by Part 6.

CALGreen Section: 5.714.7.3 Carbon dioxide (CO_2) monitoring. [BSC] For buildings equipped with demand control ventilation, CO_2 sensors and ventilation controls shall be specified and installed in accordance with the requirements of 2010 California Energy Code, Section 121(c).

Intent:
This section intends to provide clarity to the code user regarding carbon dioxide monitoring systems to protect occupant health and minimize GHG emissions. It is limited to additions and
alterations to buildings equipped with demand control ventilation and as provided in the California
Energy Code, Part 6, Title 24.

Compliance and Enforcement: See **§ 5.506.2** of this guide

NONRESIDENTIAL, HIGH-RISE RESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES—MANDATORY REQUIREMENTS

be reduced below the level required by Section 121(b)2 for up to 5 minutes each hour if the average rate for each hour is equal to or greater than the required ventilation rate.

Note: VAV must comply with Section 121(c)1 at minimum supply airflow.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 121(b)2 or three complete air changes shall be supplied to the entire building during the one-hour period immediately before the building is normally occupied.
3. **Required demand control ventilation.** HVAC systems with the following characteristics shall have demand ventilation controls complying with Section 121(c)4:
   A. They have an air economizer; and
   B. They serve a space with a design occupant density, or a maximum occupant load factor for egress purposes in the CBC, greater than or equal to 25 people per 1000 ft^2 (40 square feet per person); and
   C. They are either:
      i. Single zone systems with any controls; or
      ii. Multiple zone systems with Direct Digital Controls (DDC) to the zone level.

      Exception 1 to Section 121(c)3: Classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1000 ft^2 per Section 121(b)2B, healthcare facilities and medical buildings, and public areas of social services buildings are not required to have demand control ventilation.

      Exception 2 to Section 121(c)3: Where space exhaust is greater than the design ventilation rate specified in Section 121(b)2B minus 0.2 cfm per ft^2 of conditioned area.

      Exception 3 to Section 121(c)3: Spaces that have processes or operations that generate dusts, fumes, mists, vapors or gases and are not provided with local exhaust ventilation, such as indoor operation of internal combustion engines or areas designated for unvented food service preparation, or beauty salons shall not install demand control ventilation.

      Exception 4 to Section 121(c)3: Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people per Section 121(b)2B.
4. **Demand control ventilation devices.**
   A. For each system with demand control ventilation, CO_2 sensors shall be installed in each room that meets the criteria of Section 121(c)3B with no less than one sensor per 10,000 ft^2 of floor space. When a zone or a space is served by more than one sensor, a signal from any sensor indicating that CO_2 is near or at the setpoint within a space shall trigger an increase in ventilation to the space;
   B. CO_2 sensors shall be located in the room between 3 ft and 6 ft above the floor or at the anticipated height of the occupants heads;
   C. Demand ventilation controls shall maintain CO_2 concentrations less than or equal to 600 ppm plus the outdoor air CO_2 concentration in all rooms with CO_2 sensors;

      Exception to Section 121(c)4C: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 121(b)2 regardless of CO_2 concentration.
   D. Outdoor air CO_2 concentration shall be determined by one of the following:
      i. CO_2 concentration shall be assumed to be 400 ppm without any direct measurement; or
      ii. CO_2 concentration shall be dynamically measured using a CO_2 sensor located within 4 ft of the outdoor air intake.
   E. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in Table 121-A times the conditioned floor area for spaces with CO_2 sensors, plus the rate required by Section 121(b)2 for other spaces served by the system, or the exhaust air rate, whichever is greater.
   F. CO_2 sensors shall be certified by the manufacturer to be accurate within plus or minus 75 ppm at a 600 and 1000 ppm concentration when measured at sea level and 25°C, factory calibrated or calibrated at start-up, and certified by the manufacturer to require calibration no more frequently than once every 5 years. Upon detection of sensor failure, the system shall provide a signal which resets to supply the minimum quantity of outside air to levels required by Section 121(b)(2) to the zone serviced by the sensor at all times that the zone is occupied.
   G. The CO_2 sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.

(d) **Ducting for zonal heating and cooling units.** Where a return plenum is used to distribute outdoor air to a zonal heating or cooling unit, which then supplies the air to a space in order to meet the requirements of Section 121(b)2, the outdoor air shall be ducted to discharge either:

1. Within 5 feet of the unit; or
2. Within 15 feet of the unit, substantially toward the unit, and at a velocity not less than 500 feet per minute.

(e) **Design and control requirements for quantities of outdoor air.** All mechanical ventilation and space-conditioning systems shall be designed with and have installed ductwork, dampers and controls to allow outside air rates to be operated at the larger of (1) the minimum levels specified in Section 121(b)1; or (2) the rate required for make-up of exhaust systems that are required for a process, for control of odors, or for the removal of contaminants within the space.

SECTION 5.507 ENVIRONMENTAL COMFORT

CALGreen Section: 5.507.4 Acoustical control. Employ building assemblies and components with Sound Transmission Class (STC) values determined in accordance with ASTM E90 and ASTM E413 or Outdoor-Indoor Sound Transmission Class (OITC) determined in accordance with ASTM E1332, using either the prescriptive or performance method in Section 5.507.4.1 or 5.507.4.2.

Exception: Buildings with few or no occupants or where occupants are not likely to be affected by exterior noise, as determined by the enforcement authority, such as factories, stadiums, storage, enclosed parking structures, and utility buildings.

5.507.4.1 Exterior noise transmission, prescriptive method. Wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall meet a composite STC rating of at least 50 or a composite OITC [Outdoor-Indoor Transmission Class (**OITC**)] rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 in the following locations:

1. Within the 65 CNEL [**COMMUNITY NOISE EQUIVALENT LEVEL** (**CNEL**)] noise contour of an airport

   Exceptions:

   1. Ldn or CNEL for military airports shall be determined by the facility Air Installation Compatible Land Use Zone (AICUZ) plan.
   2. Ldn or CNEL for other airports and heliports for which a land use plan has not been developed shall be determined by the local general plan noise element.

2. Within the 65 CNEL or L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source as determined by the Noise Element of the General Plan

5.507.4.1.1 Noise exposure where noise contours are not readily available. Buildings exposed to a noise level of 65 dB Leq-1-hr during any hour of operation shall have exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 (or OITC 30).

5.507.4.2 Performance method. For buildings located as defined in Sections A5.507.4.1 or A5.507.4.1.1, wall

and roof-ceiling assemblies exposed to the noise source making up the building envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level (L_{eq}-1Hr) of 50 dBA in occupied areas during any hour of operation.

5.507.4.2.1 Site features. Exterior features such as sound walls or earth berms may be utilized as appropriate to the project to mitigate sound migration to the interior.

5.507.4.2.2 Documentation of compliance. An acoustical analysis documenting complying interior sound levels shall be prepared by personnel approved by the architect or engineer of record.

5.507.4.3 Interior sound transmission. Wall and floor-ceiling assemblies separating tenant spaces and tenant spaces and public places shall have an STC of at least 40.

Note: Examples of assemblies and their various STC ratings may be found at the California Office of Noise Control: http://www.toolbase.org/PDF/CaseStudies/stc_icc_ratings.pdf .

Intent:
Where buildings are sited in the noisy areas described in this provision, the intent is to keep sound levels low enough to carry out the activities that take place inside the building without the distraction or discomfort of unwanted noise.

Change for 2012: This section is proposed for modification in response to comment to include performance and prescriptive measures to achieve compliance with exterior noise transmission, using measurements recognized in acoustical industry practice. It coordinates noise exposure locations with those cited in local general plans and aligns also with Chapter 12 of the California Building Code for noise control in residential occupancies regulated by HCD.

Existing Law or Regulation:
There is **NO** current law or regulation for this code provision for nonresidential buildings. There may be local ordinances that apply in those communities that have noise exposure such as commercial airports.

Compliance Method:
Design Team: The designer should determine if a building's location requires compliance, then specify and detail wall and ceiling assemblies and show in the construction documents, show on

plans and/or sections the placement of sound walls and floor/ceilings.

Contractor: The contractor should install the wall and ceiling assemblies as designed.

Suggestion:
Employing the services of an acoustical engineer is another option to assist with compliance and is required if using the performance method. Choose an assembly from the "examples of assemblies" link that meet the corresponding sound ratings class.

Note: *Examples of assemblies and their various STC ratings may be found at:*
http://www.toolbase.org/PDF/CaseStudies/stc_icc_ratings.pdf .

Enforcement:
Plan Intake: The reviewer and/or plan checker should review the plans, specifications and calculations to confirm that STC ratings are included which meet the requirements of this section.

On-Site Enforcement: The inspector should review the permit set of plans and product data sheets to verify that complying wall and ceiling assemblies are installed correctly.

CALGreen Section: 5.714.7.4.1 Acoustical control. Employ building assemblies and components with Sound Transmission Class (STC) values determined in accordance with ASTM E90 and ASTM E413 or Outdoor-Indoor Sound Transmission Class (OITC) determined in accordance with ASTM E1332 using either the prescriptive or performance method in Section 5.714.1.1 or 5.714.1.2.

Exception: Buildings with few or no occupants or where occupants are not likely to be affected by exterior noise, as determined by the enforcement authority, such as factories, stadiums, storage, enclosed parking structures, and utility buildings.

5.714.7.4.2 Exterior noise transmission, prescriptive method. Wall and roof-ceiling assemblies exposed to the noise source making up the building addition or altered envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 in the following building locations:

1. Within the 65 CNEL noise contour of an airport

Exceptions:
1. L_{dn} or CNEL for military airports shall be determined by the facility Air Installation Compatible Land Use Zone (AICUZ) plan.
2. L_{dn} or CNEL for other airports and heliports for which a land use plan has not been developed shall be determined by the local general plan noise element.

2. Within the 65 CNEL or L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source as determined by the Noise Element of the General Plan

5.714.7.4.2.1 Noise exposure where noise contours are not readily available. Buildings exposed to a noise level of 65 dB (L_{eq}-1Hr) during any hour of operation shall have building addition or alteration exterior wall and roof-ceiling assemblies exposed to the noise source meeting a composite STC rating of at least 45 (or OITC 35), with exterior windows of a minimum STC of 40 (or OITC 30).

5.714.7.4.2.2 Performance method. For buildings located as defined in Sections A5.714.7.1.1 or A5.714.7.1.1.1, wall and roof-ceiling assemblies exposed to the noise source making up the building addition or altered envelope shall be constructed to provide an interior noise environment

attributable to exterior sources that does not exceed an hourly equivalent noise level (L_{eq}-1Hr) of 50 dBA in occupied areas during any hour of operation.

5.714.7.4.2.3 Site features. Exterior features such as sound walls or earth berms may be utilized as appropriate to the addition or alteration project to mitigate sound migration to the interior.

5.714.7.4.2.4 Documentation of compliance. An acoustical analysis documenting complying interior sound levels shall be prepared by personnel approved by the architect or engineer of record.

5.714.7.4.3 Interior sound transmission. Wall and floor-ceiling assemblies separating tenant spaces and tenant spaces and public places in additions and in alterations modifying existing partitions or installing new partitions shall have an STC of at least 40.

Note: Examples of assemblies and their various STC ratings may be found at the California Office of Noise Control: http://www.toolbase.org/PDF/CaseStudies/stc_icc_ratings.pdf .

Intent:
CBSC adopted these sections as modified for new construction to provide clarity to the code user regarding environmental acoustics. When installed as part of an addition or alteration, new exterior walls and roof-ceiling assemblies in buildings located near specified noise-producing neighbors, as well as new wall and floor-ceiling assemblies separating tenants inside the building, shall comply. The proposed provisions are intended to have a positive health and psychological impact on building occupants and promote healthy work attendance and increased productivity.

Compliance and Enforcement: See **§ 5.507** of this guide

SECTION 5.508 OUTDOOR AIR QUALITY

CALGreen Section: 5.508.1 Ozone depletion and greenhouse gas reductions. Installations of HVAC, refrigeration and fire suppression equipment shall comply with Sections 5.508.1.1 and 5.508.1.2.

5.508.1.1 Chlorofluorocarbons (CFCs.) Install HVAC, refrigeration and fire ~~suppression equi~~pment that do not contain CFCs.

5.508.1.2 Halons. Install HVAC, refrigeration and fire suppression equipment that do not contain Halons.

Intent:

This measure eliminates the use of chlorofluorocarbons and Halons in fire suppression, HVAC and refrigeration systems in order to assist in meeting statewide requirements for the reduction of greenhouse gas emissions to 1990 levels and to prevent ozone destruction.

Existing Law or Regulation:

Refrigerants are regulated at the federal level by the Environmental Protection Agency and those containing ozone depleting chemicals are being gradually phased out. In California, the Global Warming Solutions Act of 2006, Assembly Bill 32 (Stats 2006, c. 488), calls for the reduction of greenhouse gas emissions to 1990 levels. Although these damaging compounds have been widely outlawed for most uses, prior to CALGreen, these issues were not addressed by the CCR Title 24 building standards.

Compliance Method:
Clearly note in appropriate place(s) in the construction documents and in the equipment specifications that the required total restriction of these compounds has been followed.

Note: *Typically, new fire suppression, HVAC and refrigeration systems are designed to operate on a new generation of refrigerants that do not contribute to greenhouse gases; but there is an inventory of CFCs and Halons used for the recharge of existing equipment. Ensure that new equipment is specified and installed, which is usually required in a new project.*

Enforcement:
Plan Intake: Enforcement provided by plan check and the on-site inspection by the building official should insure the drawing and installation requirements have been met and that no HVAC, fire suppression or refrigeration systems installed use the above mentioned environmental contaminants.

On-Site Enforcement: The inspector should review the permit set of plans and product data sheets to verify that complying equipment is installed. Inspection of this equipment may be combined with verification of building commissioning or testing and adjusting.

CALGreen Section: 5.714.8 Ozone depletion and greenhouse gas reductions. Installations of
HVAC, refrigeration and fire suppression equipment shall comply with Sections 5.508.1.1 and 5.508.1.2.
5.714.8.1 Chlorofluorocarbons (CFCs.) Install HVAC, refrigeration and fire suppression equipment that do not contain CFCs.
5.714.8.2 Halons. Install HVAC, refrigeration and fire suppression equipment that do not contain Halons.

Intent:
These sections mean to provide clarity to the code user regarding the installation of HVAC, refrigeration, and fire suppression systems that use chlorofluorocarbons (CFCs) and halons. Currently, federal law prohibits the use of CFCs and halons in new installations, but they are still available for use in existing systems. Since most contracts for construction require new equipment installed as part of additions or alterations, building owners and contractors are predisposed to comply and assist with the reduction of greenhouse gas emissions from structures, one of the primary goals of the CALGreen Code.

Compliance and Enforcement: See **§ 5.508** of this guide

SECTION 5.712 WATER EFFICIENCY AND CONSERVATION
SUBSECTION 5.712.3 INDOOR WATER USE

CALGreen Section: 5.712.3.1 Meters. Separate submeters or metering devices shall be installed for the uses described in Sections 5.712.3.1.1 and 5.713.3.1.2.

5.712.3.1.1 Additions to existing buildings in excess of 50,000 square feet (4645 m^2).

Separate submeters shall be installed as follows:

1. For each individual leased, rented, or other tenant space within the building projected to consume more than 100 gal/day (380 L/day), including, but not limited to, spaces used for laundry or cleaners, restaurant or food service, medical or dental office, laboratory, or beauty salon or barber shop.
2. Where meters for individual building tenants are unfeasible, for water supplied to the following subsystems:
   a. Makeup water for cooling towers where flow through is greater than 500 gpm (30L/s)
   b. Makeup water for evaporative coolers greater than 6 gpm (0.04 L/s)
   c. Steam and hot-water boilers with energy input more than 500,000 Btu/h (147 kW)

5.712.3.1.2 Excess consumption. Any addition or added space within an addition that is projected to consume more than 1,000 gal/day (3800 L/day).

Intent:
The intent of this section and subsections means to provide clarity to the code user regarding the use of meters, submeters, and metering devices. For

buildings in excess of 50,000 s.f., additions that result in high water-using tenancy or new subsystems would be subject to these provisions.
For smaller projects, additions that project very high water use would also need to have separate submeters. The meters are intended as a means of water conservation, a high priority for California, where water is scarce.

Compliance and Enforcement: See **§ 5.303.1** of this guide

SUBSECTION 5.712.4 – OUTDOOR WATER USE

CALGreen Section: 5.712.4.1 Water budget. A water budget shall be developed for landscape irrigation use installed in conjunction with addition or alteration that conforms to the local water efficient landscape ordinance or to the California Department of Water Resources Model Water Efficient Landscape Ordinance where no local ordinance is applicable.

Note: Prescriptive measures to assist in compliance with the water budget are listed in Sections 492.5 through 492.8, 492.10 and 492.11 of the ordinance, which may be found at: http://www.owue.water.ca.gov/landscape/ord/ord.cfm

Intent:
CBSC adopted this section for developing a water budget for landscape irrigation installed in conjunction with additions or alterations.

Compliance and Enforcement: See **§ 5.304.1** of this guide

CALGreen Section: 5.712.4.2 Outdoor potable water use. For building addition or alteration requiring upgraded water service for landscaped areas of at least 1000 square feet but not more than 5000 square feet (the level at which Water Code §535 applies), separate submeters or metering devices shall be installed for outdoor potable water use.

Intent:
CBSC adopted this section for submeters or metering devices when additions or alterations require upgraded water service for landscaped areas between 1000 and 5000 s.f. The purpose is primarily to alert building owners and operator to excess dry season irrigation and thus conserve
water.

Compliance and Enforcement: See **§ 5.304.2** of this guide

CALGreen Section: 5.712.4.3 Irrigation design. In building addition or alteration with at least 1000 square feet but not more than 2500 square feet of cumulative landscaped area (the level at which the MLO applies), install irrigation controllers and sensors which include the following criteria, and meet manufacturer's recommendations.

Exception: New irrigation controllers are not required when existing irrigation controllers have sufficient capacity to serve the new landscaped area.

[Balance of subsections are unchanged from those in Division 5.3]

Intent:
CBSC adopted use of weather- or soil moisture-based irrigation controllers and rain sensors where additions or alterations increase landscaped area to between 1000 and 2500 s.f. These controllers are designed to direct the right amount of water to landscape plants and prevent excess dry season irrigation.

Compliance and Enforcement: See **§ 5.304.3 & § 5.304.3.1** of this guide

Condensed Version:

Material Conservation and Resource Efficiency

5.408 Construction waste reduction, disposal and recycling
– New options: Waste management company
– New option: Waste stream reduction (2 lb/sq. ft.)
– Exception for contaminated excavated soil and land clearing debris from being re-used or recycled

5.410.1 Commissioning. Exceptions for:
– Dry warehouses
– Conditioned accessory under 10,000 sq ft within dry warehouses
– Initial tenant improvements under 10,000 sq ft

Environmental Quality

5.504 Pollutant control
– **Temporary ventilation.**
Use MERV 8 filter if HVAC is used for ventilation during construction
– **Carpet systems.** Change to one of the referenced standards
– **Resilient flooring systems.** Change to referenced standard
– **Filters.** Added exception or return air and return with pre-filtered outside air (ductless HP)

5.507.4 Acoustical control
- STC : Sound transmission class
- OITC : Outdoor-indoor sound transmission class
- CNEL : Community noise equivalent level
-Distance to airports and freeways are removed
- Envelope: STC 50 or OITC 40, Windows: STC 40 as 30) or OITC 30 for:
o Within 65 CNEL noise contour of an airport

o Within 65 CNEL or Ldb noise contour of a freeway, expressway, railroad, industrial or other sources determined by the General Plan

- Buildings exposed to 65 dB where noise contours are not available:

o Envelope: STC 45 or OITC 35,

Windows: STC 40 or OITC 30 - Performance method: provide interior noise environment not exceeding 50 dBA

Additions and Alterations to Existing Buildings

Division 5.7 – Additions and alterations to existing nonresidential buildings

•July 1, 2012 : 2,000 sq ft additions, $500,000 alterations •2013 Code: 1,000 sq ft additions, $200,000 alterations •New Division 5.7“Additions and alterations to existing nonresidential buildings” (State definitions)

- **Notable differences:**

–**Storm water pollution prevention.**
Applies to additions

–**Bicycle parking.**
If 10 or more parking spaces being generated

–**Designated parking.**
If 10 or more parking spaces being generated

–**Grading and paving.**
When drainage path is effected

– **Irrigation controller.**
Only applied to landscape areas between 1000-2500.

– **Recycling by occupant.**

Triggered when there is an increase in floor area of 30% or more in 12 month

– **Testing and adjusting of new systems only (no commissioning)**

Appendix

New Appendix A6

– Commissioning standards

– Forms ∞

Cal Green Supplement Code Change: Residential - Most Important Changes

Chapter	SECTION	Residential MEASURES	2013 CALGREEN REQUIREMENTS AND CHANGES FROM 2010 CALGREEN
1 Administration			
	101.3.1	State-regulated buildings	REVISED: Expands the scope of CALGreen to include ALL low-rise, high-rise, and hotel/motel buildings of Group R occupancy.
2 Definitions			
	202	Definitions	NEW: Relocates all definitions to Chapter 2. Other chapters include only defined terms and a reference to Chapter 2.
			REVISED: Modifies "residential building" to include "low-rise residential buildings" and “high-rise residential buildings.”
			REVISED: Clarifies "low-rise residential building" as a Group R occupancy that is 3 stories or less and deletes reference to one- or two-family dwellings or townhouses.
			NEW: Defines “high-rise residential building” as a Group R occupancy that is 4 stories or greater in height.
3 Green Buildings			
	301.1.1	Additions and alterations	NEW: Clarifies that mandatory measures in Chapter 4 apply to additions or alterations of residential buildings and specifies that requirements only apply to the specific area of the addition or alteration.
			NEW: Adds a note directing code users to review Civil Code, Section 1101.1 et seq., regarding mandatory replacement of non-compliant plumbing fixtures.

	301.2	Low-Rise and High-Rise Residential Buildings	NEW: Clarifies that CALGreen may apply to either low-rise or high-rise residential buildings or both.
			NEW: New “banners” [LR] and [HR+] as identifying provisions applying only to low-rise or high-rise residential structures, respectively.

4 Residential

Division 4.1	**PLANNING AND DESIGN (SITE DEVELOPMENT)**		
	4.106.2	Storm Water Drainage and Retention During Construction	NO CHANGE FROM 2010 CALGREEN Projects which disturb less than one acre of soil and are not part of a larger common plan of development shall manage storm water drainage during construction.
	4.106.3	Grading and Paving	NO CHANGE FROM 2010 CALGREEN Construction plans shall indicate how the site grading or drainage system will manage all surface water flows to keep water from entering buildings. NEW EXCEPTION: Revision provides an exception for additions and alterations not altering the drainage path.

Division 4.2 -	**ENERGY EFFICIENCY**		
	4.201.1/ 5.201.1	Scope	REVISED: Energy efficiency requirements for low-rise residential (Section 4.201.1) and high-rise residential/hotel/motel (Section 5.201.1) are now in both residential and nonresidential chapters of CALGreen.

			REVISED: Standards for residential buildings do not require compliance with levels of minimum energy efficiency beyond those required by the 2013 California Energy Code [code reference date updated from 2010 to 2013].

Division 4.3 - WATER EFFICIENCY AND CONSERVATION (INDOOR WATER USE)

4.303.1	Water Conserving Plumbing Fixtures and Fittings	REVISED: 20% reduction of water use are now prescriptively designated within CALGREEN text.
		REPEALED: Prescriptive and performance methodology, Tables 4.303.1 and 4.303.2.
		NEW: Plumbing fixtures and fittings shall comply with the following:
		4.303.1.1 Waters Closets: ≤ 1.28 gal/flush
		4.303.1.2 Urinals: ≤ 0.5 gal/flush
		4.303.1.3.1 Single Showerheads: ≤ 2.0 gpm @ 80 psi
		4.303.1.3.2 Multiple Showerheads: combined flow rate of all showerheads and/or other shower outlets controlled by a single valve shall not exceed 2.0 gpm @ 80 psi or only one shower outlet is to be in operation at a time
		4.303.1.4.1 Residential Lavatory Faucets: ≤ 1.5 gpm @ 60 psi
		4.303.1.4.2 Lavatory Faucets in Common and Public Use Areas of Residential Buildings: ≤ 0.5 gpm @ 60 psi
		4.303.1.4.3 Metering Faucets: ≤ 0.25 gallons per cycle
		4.303.1.4.4 Kitchen Faucets: ≤ 1.8 gpm @ 60 psi; temporary increase to 2.2 gpm allowed but shall default to 1.8 gpm

	4.303.2	Standards for Plumbing Fixtures and Fittings	REVISED: Specifies that plumbing fixtures and fittings shall be installed in accordance with the California Plumbing Code.
			REVISED: Relocates provisions for multiple showerheads to Section 4.303.1.3.2.
			REPEALED: Table 4.303 "Standards for Plumbing Fixtures and Fixture Fittings." Code users are directed, in Section 4.303.2, to the California Plumbing Code for applicable reference standards.

Division 4.3 - WATER EFFICIENCY AND CONSERVATION (OUTDOOR WATER USE)

4.304.1	Irrigation Controllers	NO CHANGE FROM 2010 CALGREEN
		Automatic irrigation system controllers for landscaping provided by the builder and installed at the time of final inspection shall comply with the following:
		1 - Controllers shall be weather- or soil moisture-based controllers that automatically adjust irrigation in response to changes in plant watering needs as weather or soil conditions change.
		2 - Weather-based controllers without integral rain sensors or communication systems that account for rainfall shall have a separate wired or wireless rain sensor which connects or communicates with the controller(s).

Division 4.4 - MATERIAL CONSERVATION & RESOURCE EFFICIENCY (ENHANCED DURABILITY & REDUCED MAINTENANCE)

	4.406.1	Rodent Proofing	REVISED: Specifies the areas needing rodent proofing are sole/bottom plates. Annular spaces around pipes, electric cables, conduits, or other openings in sole/bottom plates at exterior walls shall be closed with cement mortar, concrete masonry or a similar method acceptable to the enforcing agency to prevent passage of rodents.

Division 4.4 - MATERIAL CONSERVATION & RESOURCE EFFICIENCY (CONSTRUCTION WASTE REDUCTION, DISPOSAL & RECYCLING)

4.408.1	Construction Waste Reduction of at least 50%	NO CHANGE FROM 2010 CALGREEN
		Recycle and/or salvage for reuse a minimum of 50% of the nonhazardous construction and demolition waste in accordance with either Section 4.408.2, 4.408.3 or 4.408.4; OR meet a more stringent local construction and demolition waste management ordinance.
		Documentation is required per Section 4.408.5.
		Exceptions:
		1 - Excavated soil and land-clearing debris.
		2 - Alternate waste reduction methods developed by working with local enforcing agencies if diversion or recycle facilities capable of compliance with this item do not exist or are not located reasonably close to the jobsite.
		3 - The enforcing agency may make exceptions to the requirements of this section when isolated jobsites are located in areas beyond the haul boundaries of the diversion facility.
4.408.2	Construction Waste	NO CHANGE FROM 2010 CALGREEN

	Management Plan	
		Submit a construction waste management plan meeting Items 1 through 5 in Section
4.408.3	Waste Management Company	NO CHANGE FROM 2010 CALGREEN
		Utilize a waste management company, approved by the enforcing agency, which can provide verifiable documentation that diverted construction and demolition waste materials meet the requirements in Section 4.408.1.
4.408.4 4.408.4.1	Waste Stream Reduction Alternative	4.408.4 Generate a total combined weight of construction and demolition waste disposed in landfills that is equal to or less than 4 pounds per square-foot of the building area.
		NEW: Adds Section 4.408.4.1 to acknowledge a high-rise residential compliance alternative.
		4.408.4.1 [HR+] Generate a total combined weight of construction and demolition waste disposed in landfills that is equal to or less than 2 pounds per square-foot of the building area.

Division 4.4 - MATERIAL CONSERVATION & RESOURCE EFFICIENCY (BUILDING MAINTENANCE & OPERATION)

4.410.1	Operation and Maintenance Manual	NO CHANGE FROM 2010 CALGREEN
		At the time of final inspection, a manual, compact disc, web-based reference or other media acceptable to the enforcing agency which covers 10 specific subject areas shall be placed in the building.

Division 4.5 - ENVIRONMENTAL QUALITY (FIREPLACES)

4.503.1	General	NO CHANGE FROM 2010 CALGREEN
		Any installed gas fireplace shall be a direct-vent sealed-combustion type. Any installed woodstove or pellet stove shall comply with U.S. EPA Phase II emission limits where applicable. Woodstoves, pellet stoves and fireplaces shall also comply with all applicable local ordinances.

Division 4.5 - ENVIRONMENTAL QUALITY (POLLUTANT CONTROL)

4.504.1	Covering of Duct Openings and Protection of Mechanical Equipment during Construction	NO CHANGE FROM 2010 CALGREEN
		At the time of rough installation, during storage on the construction site and until final startup of the heating, cooling and ventilating equipment, all duct and other related air intake and distribution component openings shall be covered. Tape, plastic, sheet metal or other methods acceptable to the enforcing agency to reduce the amount of water, dust and debris entering the system may be used.

4.504.2.1	Adhesives, Sealants and Caulks	NO CHANGE FROM 2010 CALGREEN
		Adhesives, sealants and caulks used on the project shall meet the requirements of the following standards unless more stringent local or regional air pollution or air quality management district rules apply:

		1 - Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in Tables 4.504.1 or 4.504.2, as applicable. Such products shall also comply with Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene and trichloroethylene), except for aerosol products as specified in Subsection 2 below.
		2 - Aerosol adhesives, and smaller unit sizes of adhesives, and sealants or caulking compounds (in units of product, less packaging, which do not weigh more than 1 pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of the California Code of Regulations, Title 17, commencing with Section 94507.

4.504.2.2	Paints and Coatings	NO CHANGE FROM 2010 CALGREEN Architectural paints and coatings shall comply with VOC limits in Table 1 of the Air Resources Board Architectural Suggested Control Measure, as shown in Table 4.504.3, unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed in Table 4.504.3 shall be determined by classifying the coating as Flat, Nonflat, or Nonflat-High Gloss coating, based on its gloss, as defined in subsections 4.21, 4.36, and 4.37, of the 2007 California Air Resources Board, Suggested Control

		Measure, and the corresponding Flat, Nonflat, or Nonflat-High Gloss VOC limit in Table 4.504.3 shall apply.

4.504.2.3	Aerosol Paints and Coatings	NO CHANGE FROM 2010 CALGREEN
		Aerosol paints and coatings shall meet the Product-Weighted MIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(c)(2) and (d)(2) of the California Code of Regulations, Title 17, commencing with Section 94520; and in areas under the jurisdiction of the Bay Area Air Quality Management District shall additionally comply with the percent VOC by weight of product limits of Regulation 8, Rule 49.

4.504.3	Carpet Systems	NO CHANGE FROM 2010 CALGREEN
		All carpet installed in the building interior shall meet the testing and product requirements of one of the following:
		1 - Carpet and Rug Institute's Green Label Plus Program
		2 - California Department of Public Health, "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Version 1.1, February 2010 (also known as Specification 01350.)

		3 - NSF/ANSI 140 at the Gold level
		4 - Scientific Certifications Systems Indoor Advantage™ Gold

4.504.3.1	Carpet Cushion	NO CHANGE FROM 2010 CALGREEN
		All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute's Green Label Program.

4.504.3.2	Carpet Adhesive	NO CHANGE FROM 2010 CALGREEN
		All carpet adhesives shall meet the requirements of Table 4.504.1.

4.504.4	Resilient Flooring Systems	REVISED: Compliance rate of resilient flooring is increased from 50% to 80%. Related changes are made for Tier 1 and Tier 2 resilient flooring measures.
		Where resilient flooring is installed, at least 80% of floor area receiving resilient flooring shall comply with one or more of the following:
		1 - VOC emission limits defined in the Collaborative for High Performance Schools (CHPS) High Performance Products Database.
		2 - Products compliant with CHPS criteria certified under the Greenguard Children & Schools program.
		3 - Certification under the Resilient Floor Covering Institute (RFCI) FloorScore program.
		4 - Meet the California Department of Public Health, “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers,” Version 1.1, February

		2010 (also known as Specification 01350.)

4.504.5	Composite Wood Products	NO CHANGE FROM 2010 CALGREEN FOR 4.504.5.
		Referenced Table 4.504.5 has been revised to delete obsolete compliance dates.
		Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in the Air Resources Board's Air Toxics Control Measure for Composite Wood (17 CCR 93120 et. seq.), on or before the dates specified in those sections as shown in Table 4.504.5. Documentation is required per Section 4.504.5.1.
		Definition of Composite Wood Products: Composite wood products include hardwood plywood, particleboard, and medium density fiberboard. "Composite wood products" do not include hardboard, structural plywood, structural panels, structural composite lumber, oriented strand board, glued laminated timber, prefabricated wood I-joists, or finger-jointed lumber, all as specified in CCR, Title 17, Section 93120.1(a).

Division 4.5 - ENVIRONMENTAL QUALITY (INTERIOR MOISTURE CONTROL)

4.505.2	Concrete Slab Foundations	NO CHANGE FROM 2010 CALGREEN

			Concrete slab foundations or concrete slab-on-ground floors required to have a vapor retarder by the California Building Code, Chapter 19, or the California Residential Code, Chapter 5, respectively, shall also comply with this section.
	4.505.2.1	Capillary Break	NO CHANGE FROM 2010 CALGREEN
			A capillary break shall be installed in compliance with at least one of the following:
			1 - A 4-inch (101.6 mm) thick base of 1/2-inch (12.7 mm) or larger clean aggregate shall be provided with a vapor retarder in direct contact with concrete and a concrete mix design which will address bleeding, shrinkage and curling shall be used. For additional information, see American Concrete Institute, ACI 302.2R-06.
			2 - Other equivalent methods approved by the enforcing agency.
			3 - A slab design specified by a licensed design professional.
	4.505.3	Moisture Content of Building Materials	NO CHANGE FROM 2010 CALGREEN
			Building materials with visible signs of water damage shall not be installed. Wall and floor framing shall not be enclosed when the framing members exceed 19% moisture content. Moisture content shall be verified in compliance with the following:
			1 - Moisture content shall be determined with either a probe-type or a contact-type moisture meter. Equivalent moisture verification methods may be approved by the enforcing agency and shall satisfy requirements in Section 101.8.

			2 - Moisture readings shall be taken at a point 2 feet (610 mm) to 4 feet (1219 mm) from the grade-stamped end of each piece to be verified.
			3 - At least three random moisture readings shall be performed on wall and floor framing with documentation acceptable to the enforcing agency provided at the time of approval to enclose the wall and floor framing.
			Insulation products which are visibly wet or have a high moisture content shall be replaced or allowed to dry prior to enclosure in wall or floor cavities. Manufacturers' drying recommendations shall be followed for wet-applied insulation products prior to enclosure.

Division 4.5 - ENVIRONMENTAL QUALITY (INDOOR AIR QUALITY & EXHAUST)

4.506.1	Bathroom Exhaust Fans	NO CHANGE FROM 2010 CALGREEN
		Each bathroom shall be mechanically ventilated and shall comply with the following:
		1 - Fans shall be ENERGY STAR compliant and be ducted to terminate outside the building.
		2 - Unless functioning as a component of a whole house ventilation system, fans must be controlled by a humidity control.
		a) Humidity controls shall be capable of manual or automatic adjustment between a relative humidity range of less than 50% to a maximum of 80%.
		b) A humidity control may be a separate component to the exhaust fan and is not required to be integral or built-in.

			Note: For CALGreen a "bathroom" is a room which contains a bathtub, shower, or tub/shower combination. Fans are required in each bathroom.
Division 4.5 - ENVIRONMENTAL QUALITY (ENVIRONMENTAL COMFORT)			
	4.507.1	Reserved	REPEALED: Section 4.507.1 Openings (for whole house fans) has been repealed. There is no substitute language.
	4.507.2	Heating and Air Conditioning System Design	NO CHANGE FROM 2010 CALGREEN
			Heating and air conditioning systems shall be sized, designed, and equipment selected using the following methods:
			1 - The heat loss and heat gain is established according to ANSI/ACCA 2 Manual J - 2004 (Residential Load Calculation), ASHRAE handbooks or other equivalent design software or methods.
			2 - Duct systems are sized according to ANSI/ACCA 1 Manual D - 2009 (Residential Duct Systems), ASHRAE handbooks or other equivalent design software or methods.
			3 - Select heating and cooling equipment according to ANSI/ACCA 3 Manual S - 2004 (Residential Equipment Selection) or other equivalent design software or methods.
			Exception: Use of alternate design temperatures necessary to ensure the system functions are acceptable.
CHAPTER 7 - INSTALLER & SPECIAL INSPECTOR QUALIFICATIONS (QUALIFICATIONS, VERIFICATIONS)			
	702.1	Installer Training	HVAC system installers shall be trained and certified in the proper installation of HVAC systems and equipment by a recognized training or certification program. Examples of acceptable HVAC

			training and certification programs include but are not limited to the following:
			1 - State certified apprenticeship programs.
			2 - Public utility training programs.
			3 - Training programs sponsored by trade, labor or statewide energy consulting or certification organizations.
			4 - Programs sponsored by manufacturing organizations.
			5 - Other programs acceptable to the enforcing agency.
	702.2	Special Inspection	NO CHANGE FROM 2010 CALGREEN
			Special inspectors must be qualified and able to demonstrate competence to the enforcing agency in the discipline in which they are inspecting.
	703.1	Documentation	NO CHANGE FROM 2010 CALGREEN
			Documentation of compliance shall include, but is not limited to, construction documents, plans, specifications, builder or installer certification, inspection reports, or other methods acceptable to the local enforcing agency. Other specific documentation or special inspections necessary to verify compliance are specified in appropriate sections of CALGreen

Non-Residential

Planning and Design	
Site Development	**Changes**

	Stormwater pollution prevention BMP	*Clarifies that it also applies to additions*
	Bicycle parking	*Updated for additions and alterations*
	Light pollution reduction	*Clarifies that it applies to new construction only*
	Grading and paving	*Exception: for additions and alterations*

Water Efficiency and Conservation

Indoor water Use		**Changes**
	Separate water submeters for subsystems	*Clarifies that it also applies to additions*
	20% reduction is indoor water use	*New sections: "Water Reduction": Comply with reduced flow rate table;*
	Prescriptive and performance standards with updated tables	*"Water conserving plumbing fixtures and fittings": Prescriptive reduced flow rates for: water closets, Urinals, and Showerheads and*
		Clarifies that it applies to effected areas of additions and alterations
		New Exceptions for performance 20% reduction
	Waste water reduction	*Clarifies that it applies to new construction only*
	Plumbing fixtures and fittings (standards)	*New Section: References The California Pluming Code*

Material Conservation and Resource Efficiency		
Weather Resistance and Moisture Management		**Changes**
	Design for moisture control	
	Entries and openings	Exterior door protection: removed notes and updated requirements

Construction Waste Reduction, Disposal and Recycling		**Changes**
	Construction waste reduction of 50%	Added demolition requirement
	Waste management plan requirements	Added demolition requirement
	Exception for isolated jobsites	Removed exception

Building Maintenance and Operation		**Changes**
	Recycling by occupants	Added clarification for ordinance requirements
		New Section: Clarifies requirements
	Building commissioning for new buildings 10,000 square feet and over	Clarifies requirements for new construction only
		Note: All energy related requirements for Commissioning, OPR & BOD now have a reference to the Energy Code

Testing and adjusting for buildings less than 10,000 square feet	New Section: Clarifies requirements for new buildings or new systems to serve additions or alterations
Temporary construction ventilation	Clarifies requirements for areas of additions or alterations

Finish materials	**Changes**
Carpet systems	Clarifies VOC emissions limits and testing
requirements	
	Added CA-CHPS to list of approved methods of compliance
Composite wood products	Clarifies the formaldehyde limits in a revised table
Resilient flooring	Clarifies VOC emissions limits and testing
	Added CA-CHPS to list of approved methods of
compliance	
Filters requirements for small H.E. ductless units	Clarifies MERV exceptions and added new exception for existing mechanical equipment
	New section: Labeling requirements

Indoor air quality	**Changes**
CO2 monitoring	Clarifies that it also applies to additions
Environmental comfort	

Exterior noise transmission	Clarifies applications to additions or altered envelope

Outdoor air quality	**Changes**
	New Sections:
	Supermarket refrigerant leakage reduction: for retail food stores 8,000 square foot or more
	Refrigerant piping: meet California Mechanical Code
	Values: meet California Mechanical Code
	Refrigerated services cases: use corrosion-resistant materials
	Refrigerant receivers: if over 200 lbs, provide level indicator
	Pressure testing: test during installation
	Evacuation: evacuate after pressure testing and prior to charging

Water Efficiency and Conservation

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012.

4.106.3. Grading and paving. Construction plans shall indicate how the site grading or drainage system will manage all surface water flows to keep water from entering buildings. Examples of methods to manage surface water include, but are not limited to, the following:

1. Swales
2. Water collection and disposal systems
3. French drains
4. Water retention gardens
5. Other water measures which keep surface water away from buildings and aid in groundwater recharge.

COMMENTARY

Purpose:
This section provides protection from unintended entry of surface water and requires construction plans to show how surface water will be managed. Site design and proper installation of drainage systems will help builders protect structures from the dangers of flooding or subsurface water infiltration. This is especially important in areas where setbacks or obstacles interfere with proper surface drainage.

Examples of Acceptable Methods of Implementation and/or Compliance:

- *Develop and implement control methods to address ground water flow both above and below the surface to ensure water flow away from the building.*
- *Channel rain gutter discharge away from the building during large or intense rain events. Builders should consider site design mimicking water flows similar to the natural environment.*
- *Additional design strategies that can be considered are:*

    - *Sloped ground surfaces*
    - *Properly placed drains*

Background:
During large rain events the ground can become saturated causing runoff and/or ponding in low-lying areas, which can cause water to migrate into buildings. It is critically important to channel rain gutter discharge away from the building during these events. Builders should consider site design that mimics water flows similar to the natural environment and incorporate methods as described in this section.

In order to keep a site well-drained and stable, designers and contractors should consider both storm water from the roof and rainwater penetrating into the area around the site. Ground water can flow above or below the surface. Control methods should be developed and implemented which allow for both types of ground water flow to ensure water can continually flow away from the building.

Frequently Asked Questions

Q: Do local storm water ordinances need findings and filing?

A: Sometimes. It is best to check with a specific local municipality about the local ordinance adoption process and required resolutions, findings and filings. Local charters typically address procedures for adopting, amending and rescinding ordinances. Ordinances typically require or prohibit certain actions under specified circumstances and include statements of intent, findings, specific actions required or prohibited, and an adoption clause. Approved ordinances are subsequently incorporated into the county or city codes.

The State Water Resources Control Board (SWRCB), Municipal Storm Water Permitting Program, regulates storm water discharges from municipal separate storm sewer systems (MS4s). Although not a formal finding, changes in local ordinances helpful to or enhancing the local storm water program will need to be reported in the local agency's annual report to the SWRCB.

Q: CALGreen Section 4.106.2 requires storm water drainage and retention during construction. Does this requirement apply year-round even though construction will occur during non-rainy season months?

A: No. This section provides three methods for complying with this section. The third method involves compliance with a local lawfully enacted storm water management ordinance. In addition, the local enforcing agency has discretion to determine whether these measures are needed based on the potential for storm water impacts during the construction period of the

project. However, if there is potential for construction to be postponed or to be extended beyond the initial planned construction phase, the local enforcing agency may consider requirements for storm water drainage and retention as permit requirements for the project.

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.303.1 Twenty percent savings. A schedule of plumbing fixtures and fixture fittings that will reduce the overall use of potable water within the building by at least 20 percent shall be provided. The reduction shall be based on the maximum allowable water use per plumbing fixture and fitting as required by the California Building Standards Code. The 20 percent reduction in potable water use shall be demonstrated by one of the following methods:

1. **Prescriptive Method.** Each plumbing fixture and fitting shall not exceed the Maximum Flow Rate at ≥ 20 Percent Reduction column in Table 4.303.2; or

2. **Performance Method.** A calculation demonstrating a 20 percent reduction in the building "water use" baseline as established in Table 4.303.1 shall be provided. For low-rise residential occupancies, the calculation shall be limited to the following plumbing fixture and fitting types: showerheads, lavatory faucets, water closets and urinals.

COMMENTARY

Purpose:
This provision helps reduce indoor potable water use. Reduction of water use also results in decreasing the amount of energy needed to transport, process and treat water, thereby contributing to reduction of greenhouse gas emissions.

Section 4.303 provides guidelines on how to achieve a 20 percent reduction in indoor water use. There are two options to use for compliance: the ***prescriptive method*** *and the* ***performance method****.*

The following graphic shows the typical breakdown of indoor water use. As shown, toilets, showers, clothes washers, and faucets are the greatest indoor water users. CALGreen focuses on water use related to toilets (water closets and urinals), faucets and showers for purposes of potable water conservation.

Indoor water use in California

The data provided in this graph is from the California Single Family Home Water Use Efficiency Study. This study was sponsored by the California Department of Water Resources, and conducted by Aquacraft, Inc. The study covers a period between 2005 and 2008; the final report was published in July 2011.

Examples of Acceptable Methods of Implementation and/or Compliance:
The mandatory effective date for 20 percent reduction is July 1, 2011. This date was selected to allow manufacturers additional time to ensure enough product was available to satisfy the construction needs of California and to ensure that the product performance standards would meet consumer expectations.

PRESCRIPTIVE METHOD DISCUSSION: *The plumbing fixtures listed below must comply with Table 4.303.2 (see "Maximum Flow Rate at ≥ 20 Percent Reduction" column).*

a) *Toilets (Water Closets): As shown in Table 4.303.2, the maximum flow rate allowed for use by a single flush toilet is 1.28 gallons/flush. The standard single flush toilet only*

allows the user to complete a full-flush with each flush regardless of waste type. A "dual flush" toilet provides the user the option based on waste type to utilize the "half flush" or "full-flush" technology. A "dual flush" toilet will have two flushing mechanisms clearly marked for each flushing option minimizing the total water used by the toilet. The "1.28 flush" for a "dual flush" toilet is measured by taking the average of three flushes: (two fluid flushes = 1.0 gal/flush) + (one solid flush = 1.6 gal/flush) x (1/3). Additional compliance models include gravity-fed single flush low-flow toilets, pressure-assisted low-flow toilets and composting or waterless toilets.

b) *Urinals: Although typically not found in a low-rise residential application, this fixture type is a viable option to reduce indoor water usage. The maximum flow rate allowed for use by a urinal is 0.5 gallons/flush to be greater than the 20 percent reduction. Many manufacturers are now producing low-flow, ultra low-flow, high efficiency and waterless urinals that are seeing water consumption ranges from 0 gal/flush to 0.125 gal/flush.*

c) *Showerheads: Studies show that approximately 20 percent of indoor water use can be directly related to showering and even modest flow rate reductions can greatly increase water savings. A showerhead is a perforated nozzle of various designs that applies water to a bather. As shown in Table 4.303.2, the maximum flow rate of a showerhead is 2 gpm @ 80psi. Showerheads with flow rates ranging from 0.5 gpm to 1.6 gpm are readily available.*

   ***Note**: Users should be aware that the 2010 California Plumbing Code allows a higher flow rate of 2.5 gpm @ 80 psi for showerheads. If a showerhead with a higher flow rate than the 2 gpm @ 80 psi flow rate in Table 4.303.2 is used, it will be necessary to use the performance-based calculation method to achieve the overall 20 percent indoor water reduction rate. If showerheads with a flow rate less than 2 gpm @ 80 psi are used, the shower controls shall be capable of providing scald protection that functions at that reduced rate.*

d) *Lavatory Faucets: Lavatory faucets provide an excellent source of water reduction. Some aerators on reduced flow faucets inject air bubbles into the water stream creating the consumer appeal of large soft water flow with less water while others provide multiple individual streams. Residential lavatory faucets must not exceed a maximum flow rate of 1.5 gpm @ 60 psi and may not be less than 0.8 gpm @ 20 psi. The 2010 CALGreen, as updated for 2012, also provides for use of nonresidential lavatory faucets at a maximum reduced flow rate of .4 gpm. Faucets must also comply with the low-lead requirements of AB 1953 as summarized in the "INFORMATIVE NOTE".*

   ***Note**: Users should be aware that the 2010 California Plumbing Code allows a higher flow rate of 2.2 gpm @ 60 psi for residential lavatory faucets. If a faucet with a higher flow rate is used, it will be necessary to use the performance-based calculation method to achieve the overall 20 percent reduction rate.*

e) *Kitchen Faucets: Kitchen faucets must not exceed a maximum flow rate of 1.8 gpm @ 60 psi as shown in Table 4.303.2. Faucets **must** also comply with the low-lead requirements of AB 1953 as summarized in the "INFORMATIVE NOTE".*

***Note 1**: The 2010 California Plumbing Code, Section 402.1.2, requirements reference a higher acceptable flow rate of 2.2 gpm @ 60 psi for kitchen faucets.*

***Note 2**: Kitchen faucets with features that temporarily increase flow rates for faster filling or stronger spray, but have default flow rates of 1.8 gpm at 60 psi, may be considered as meeting the prescriptive requirements of Table 4.303.2. The maximum flow of kitchen faucets, even at the higher flow rates, shall not exceed 2.2 gpm at 60 psi.*

f) *Verify with local jurisdictions if there are any special conditions which may preclude use of low-water use toilets or urinals.*

PE INFORMATIVE
NOTE
AB 1953: Lead-Free Plumbing Law Effective 1/1/10

Legislation redefining what constitutes "lead-free plumbing" took effect on January 1, 2010. Signed into law in 2006, AB 1953 effectively reduced the maximum amount of allowable lead content in plumbing pipes, fixtures and fittings used for potable (drinking) water to ***0.25 percent.***

When initially signed into law, there were no major manufacturers with compliant product. That situation has changed in a big way over the past three years. The Plumbing Manufacturers Institute (PMI), recently renamed Plumbing Manufacturers International, has announced that there is a substantial supply of compliant products now on the market. Further information regarding manufacturers and products can be found at PMI's website at www.pmihome.org.

Follow-up legislation, SB 1334 (Calderon) and SB 1395 (Corbett), requires all plumbing products, as defined, to be certified by an independent ANSI-accredited third party for compliance with existing lead standards. This follow-up legislation should make it easier for homebuilders and purchasing agents to obtain documentation that they are indeed purchasing AB 1953-compliant products.

RFORMANCE METHOD DISCUSSION: *A calculation demonstrating a 20 percent reduction in the building "water use" baseline as established in Table 4.303.1 shown below shall be provided. For low-rise residential occupancies, the calculation shall be limited to the following plumbing fixture and fitting types: water closets, urinals, lavatory faucets and showerheads. The following example calculations will assist in determining compliance with this method.*

TABLE 4.303.1
WATER USE BASELINE[1]

FIXTURE TYPE	BASELINE FLOW RATE	DURATION	DAILY USES	OCCUPANTS[2]
Showerheads residential	2.5 gpm @ 80 psi	8 min.	1	
Lavatory faucets, residential	2.2 gpm @ 60 psi	.25 min.	3	
Lavatory faucets, nonresidential	0.5 gpm @ 60 psi	.25 min.	3	
Kitchen faucets	2.2 gpm @ 60 psi	4 min.	1	
Replacement aerators	2.2 gpm @ 60 psi			

Gravity tank type water closets	1.6 gallons/flush	1 flush	1 male[3] 3 female	
Flushometer tank water closets	1.6 gallons/flush	1 flush	1 male[3] 3 female	
Flushometer valve water closets	1.6 gallons/flush	1 flush	1 male[3] 3 female	
Electromechanical hydraulic water closets	1.6 gallons/flush	1 flush	1 male[3] 3 female	
Urinals	1.0 gallons/flush	1 flush	2 male	

Fixture "Water Use" = Flow rate x Duration x Occupants x Daily uses

1. Use Worksheet WS-1 to calculate baseline water use.
2. For low-rise residential occupancies, the number of occupants shall be based on two persons for the first bedroom, plus one additional person for each additional bedroom.
3. The daily use number shall be increased to three if urinals are not installed in the room.

TABLE 4.303.2
FIXTURE FLOW RATES

FIXTURE TYPE	BASELINE FLOW RATE	MAXIMUM FLOW RATE AT ≥ 20 PERCENT REDUCTION
Showerheads	2.5 gpm @ 80 psi	2 gpm @ 80 psi
Lavatory faucets, residential	2.2 gpm @ 60 psi	1.5 gpm @ 60 psi[1]
Lavatory faucets, nonresidential	0.5 gpm @ 60 psi	0.4 gpm @ 60 psi[2]
Kitchen faucets	2.2 gpm @ 60 psi	1.8 gpm @ 60 psi [3]
Gravity tank type water closets	1.6 gallons/flush	1.28 gallons/flush[4]
Flushometer tank water closets	1.6 gallons/flush	1.28 gallons/flush [4]
Flushometer valve Water Closets	1.6 gallons/flush	1.28 gallons/flush[4]
Electromechanical hydraulic water closets	1.6 gallons/flush	1.28 gallons/flush[4]
Urinals	1.0 gallons/flush	.5 gallons/flush

1. Lavatory faucets shall not have a flow rate less than 0.8 gpm at 20 psi.
2. Where complying faucets are unavailable, aerators rated at .35 gpm or other means may be used to achieve reduction.
3. Kitchen faucets may temporarily increase flow above the maximum rate, but not above 2.2 gpm @ 60 psi and must default to a maximum flow rate of 1.8 gpm @ 60 psi.
4. Includes single and dual flush water closets with an effective flush of 1.28 gallons or less.

   Single flush toilets - The effective flush volume shall not exceed 1.28 gallons (4.8 liters). The effective flush volume is the average flush volume when tested in accordance with ASME A112.19.2.

   Dual flush toilets - The effective flush volume shall not exceed 1.28 gallons (4.8 liters). The effective flush volume is defined as the composite, average flush volume of two reduced flushes and one full flush. Flush volumes will be tested in accordance with ASME A112.19.2 and ASME A112.19.14.

Note: Flow rates in the second column are baseline flow rates from Table 4.303.1.

Background:
Provisions for a 20 percent reduction in indoor water use were introduced in the 2008 CALGreen Code. These provisions utilized the minimum appliance flow rates for showerheads, faucets and other plumbing fixtures and fittings pursuant to the California Appliance Efficiency Regulations

(California Code of Regulations, Title 20). For implementation purposes, HCD provided a prescriptive 20 percent reduction in the flow rate of each fixture based on requirements in the 2010 Appliance Efficiency Regulations and a performance-based calculation method. With the 2010 CALGreen Code, 20 percent water reduction for indoor water use was mandated on or after July 1, 2011. The 2010 CALGreen Code also permits indoor water use reduction in excess of the 20 percent.

MEDIUM HOME SIZE EXAMPLE

No. of Stories: *2*
Square Footage: *2,400*
Bedrooms: *4*
Occupants: *5 (2 for first bedroom + 1 for each additional bedroom per WS-1)*
Daily uses = 3 male + 3 female = 6 per WS-1 per Footnote 1
(no urinals in structure)

SAMPLE BASELINE WATER USE CALCULATION TABLE FOR MEDIUM SIZE HOME EXAMPLE

BASELINE WATER USE CALCULATION TABLE									
FIXTURE TYPE	**FLOW RATE (gpm)**		**DURATION**		**DAILY USES**		**OCCUPANTS[1,2]**		**GALLONS PER DAY**
Showerheads	2.5	X	5 min.	X	1	X		=	N/A
Showerheads Residential	2.5	X	8 min.	X	1	X	5	=	100
Lavatory Faucets Residential	2.2	X	.25 min.	X	3	X	5	=	8.25
Lavatory Faucets Nonresidential	.5	X	.25 min.	X	3			=	
Kitchen Faucets	2.2	X	4 min.	X	1	X		=	N/A
Replacement Aerators	2.2	X		X		X		=	N/A
Wash Fountains	2.2	X		X		X		=	N/A
Metering Faucets	0.25	X	.25 min.	X	3	X		=	N/A
Metering Faucets for Wash Fountains	2.2	X	.25 min.	X		X		=	N/A
Gravity tank type Water Closets	1.6	X	1 flush	X	6	X	5	=	48
Flushometer Tank Water Closets	1.6	X	1 flush	X	1 male[3] 3 female	X		=	N/A

Flushometer Valve Water Closets	1.6	X	1 flush	X	1 male[3] 3 female	X		=	N/A
Electromechanical Hydraulic Water Closets	1.6	X	1 flush	X	1 male[3] 3 female	X		=	N/A
Urinals	1.0	X	1 flush	X	2 male	X		=	N/A

Fixture "Water Use" = Flow rate x Duration x Occupants x Daily Uses

*Example **Baseline** Calculation:*

Showerheads = 2.5 gpm x 8 min x 1 (daily use) x 5 (occupants) = 100 Gallons per day
Lavatory Faucets = 2.2 gpm x 0.25 min x 3 (daily uses) x 5 (occupants) = 8.25 Gallons per day
Water Closets = 1.6 gpm x 1 gal/flush x 6 (daily uses) x 5 (occupants) = 48 Gallons per day
Urinals = Not included in calculation
***Total Daily Baseline Water Use** = 156.25 Gallons per day*

SAMPLE 20 PERCENT REDUCTION WATER USE CALCULATION TABLE FOR MEDIUM SIZE HOME EXAMPLE

20 PERCENT REDUCTION WATER USE CALCULATION TABLE									
FIXTURE TYPE	**FLOW RATE (gpm)[1]**		**DURATION**		**DAILY USES**		**OCCUPANTS[2,3]**		**GALLONS PER DAY**
Showerheads		X	5 min.	X	1	X		=	N/A
Showerheads Residential	2.0	X	8 min.	X	1	X	5	=	80
Lavatory Faucets Residential	1.5	X	.25 min.	X	3	X	5	=	5.63
Lavatory Faucets Nonresidential		X	.25 min.	X	3	X		=	
Kitchen Faucets		X	4 min.	X	1	X		=	N/A
Replacement Aerators		X		X		X		=	N/A
Wash Fountains		X		X		X		=	N/A
Metering Faucets		X	.25 min.	X	3	X		=	N/A
Metering Faucets for Wash Fountains		X	.25 min.	X		X		=	N/A
Gravity tank type Water Closets	1.28	X	1 flush	X	6	X	5	=	38.4
HET [4] High Efficiency Toilet	1.28	X	1 flush	X	1 male[5] 3 female	X		=	N/A
Flushometer Tank Water Closets		X	1 flush	X	1 male[5] 3 female	X		=	N/A
Flushometer Valve Water Closets		X	1 flush	X	1 male[5] 3 female	X		=	N/A
Electromechanical Hydraulic Water Closets		X	1 flush	X	1 male[5] 3 female	X		=	N/A

Urinals		X	1 flush	X	2 male	X			N/A
Urinals Non-Water Supplied	0.0	X	1 flush	X	2 male	X		=	N/A

*Example **Proposed** Calculation: **20 Percent Reduction***

Showerheads = 2.0 gpm x 8 min x 1 (daily use) x 5 (occupants) = 80 Gallons per day
Lavatory Faucets = 1.5 gpm x 0.25 min x 3 (daily uses) x 5 (occupants) = 5.63 Gallons per day
Water Closets = 1.28 gpm x 1 gal/flush x 6 (daily uses) x 5 (occupants) = 38.4 Gallons per day
Urinals = Not included in calculation

Total Daily Proposed Water Use = *124.03 Gallons per day ≤ 125 Gallons per day (20 Percent Reduction of 156.25 Gallons per day Baseline)*

SMALL HOME SIZE EXAMPLE

No. of Stories: *1*
Square Footage: *1,200*
Bedrooms: *3*
Occupants: *4 (2 for first bedroom + 1 for each additional bedroom per WS-1)*
Daily uses = 3 male + 3 female = 6 per WS-1 per Footnote 1
(no urinals in structure)

SAMPLE BASELINE WATER USE CALCULATION TABLE FOR SMALL SIZE HOME EXAMPLE

BASELINE WATER USE CALCULATION TABLE									
FIXTURE TYPE	**FLOW RATE (gpm)**		**DURATION**		**DAILY USES**		**OCCUPANTS[1,2]**		**GALLONS PER DAY**
Showerheads	2.5	X	5 min.	X	1	X		=	N/A
Showerheads Residential	2.5	X	8 min.	X	1	X	4	=	80
Lavatory Faucets Residential	2.2	X	.25 min.	X	3	X	4	=	6.6
Lavatory Faucets Nonresidential	0.5	X	.25 min.						
Kitchen Faucets	2.2	X	4 min.	X	1	X		=	N/A
Replacement Aerators	2.2	X		X		X		=	N/A
Wash Fountains	2.2	X		X		X		=	N/A
Metering Faucets	0.25	X	.25 min.	X	3	X		=	N/A
Metering Faucets for Wash Fountains	2.2	X	.25 min.	X		X		=	N/A
Gravity tank type Water Closets	1.6	X	1 flush	X	6	X	4	=	38.4
Flushometer Tank Water Closets	1.6	X	1 flush	X	1 male[3] 3 female	X		=	N/A

Flushometer Valve Water Closets	1.6	X	1 flush	X	1 male[3] 3 female	X		=	N/A
Electromechanical Hydraulic Water Closets	1.6	X	1 flush	X	1 male[3] 3 female	X		=	N/A
Urinals	1.0	X	1 flush	X	2 male	X		=	N/A

*Example **Baseline** Calculation:*

Showerheads = 2.5 gpm x 8 min x 1 (daily use) x 4 (occupants) = 80 Gallons per day
Lavatory Faucets = 2.2 gpm x 0.25 min x 3 (daily uses) x 4 (occupants) = 6.6 Gallons per day
Water Closets = 1.6 gpm x 1 gal/flush x 6 (daily uses) x 4 (occupants) = 38.4 Gallons per day
Urinals = Not included in calculation
***Total Daily Baseline Water Use** = 125 Gallons per day*

SAMPLE 20 PERCENT REDUCTION WATER USE CALCULATION TABLE FOR SMALL SIZE HOME EXAMPLE

20 PERCENT REDUCTION WATER USE CALCULATION TABLE									
FIXTURE TYPE	**FLOW RATE (gpm)[1]**		**DURATION**		**DAILY USES**		**OCCUPANTS[2,3]**		**GALLONS PER DAY**
Showerheads		X	5 min.	X	1	X		=	N/A
Showerheads Residential	2.0	X	8 min.	X	1	X	4	=	64
Lavatory Faucets Residential	1.5	X	.25 min.	X	3	X	4	=	4.5
Lavatory Faucets Nonresidential	0.5	X	.25 min.	X	3	X		=	
Kitchen Faucets		X	4 min.	X	1	X		=	N/A
Replacement Aerators		X		X		X		=	N/A
Wash Fountains		X		X		X		=	N/A
Metering Faucets		X	.25 min.	X	3	X		=	N/A
Metering Faucets for Wash Fountains		X	.25 min.	X		X		=	N/A
Gravity tank type Water Closets	1.28	X	1 flush	X	6	X	4	=	30.72
HET[4] High Efficiency Toilet	1.28	X	1 flush	X	1 male[5] 3 female	X		=	N/A
Flushometer Tank Water Closets		X	1 flush	X	1 male[5] 3 female	X		=	N/A
Flushometer Valve Water Closets		X	1 flush	X	1 male[5] 3 female	X		=	N/A
Electromechanical Hydraulic Water Closets		X	1 flush	X	1 male[5] 3 female	X		=	N/A

Urinals		X	1 flush	X	2 male	X			N/A
Urinals Non-Water Supplied	0.0	X	1 flush	X	2 male	X		=	N/A

*Example **Proposed** Calculation: **20 Percent Reduction***

Showerheads = 2.0 gpm x 8 min x 1 (daily use) x 4 (occupants) = 64 Gallons per day Lavatory Faucets = 1.5 gpm x 0.25 min x 3 (daily uses) x 4 (occupants) =4.5 Gallons per day Water Closets = 1.28 gpm x 1 gal/flush x 6 (daily uses) x 4 (occupants) = 30.72 Gallons per day Urinals = Not included in calculation

***Total Daily Proposed Water Use** = 99.22 Gallons per day ≤ 100 Gallons per day (20 Percent Reduction of 125 Gallons per day Baseline)*

4.303.2 Multiple showerheads serving one shower **C**ontrolled by a single valve

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.303.2 Multiple showerheads serving one shower. When a shower is served by more than one showerhead, the combined flow rate of all the showerheads controlled by a single valve shall not exceed the Maximum Flow Rates at ≥ 20 Percent Reduction column in Table 4.303.2 or the shower shall be designed to only allow one showerhead to be in operation at a time.

Exception: The maximum flow rate for showerheads when using the performance method specified in Section 4.303.1, Item 2, is 2.5 gpm @ 80 psi.

COMMENTARY

The maximum flow rate established in Table 4.303.2, Maximum Flow Rate at ≥ 20 Percent Reduction column, also covers applications where one or more valves supply multiple showerheads in a single shower enclosure or space. "Fixture types" or sources of water flow include but are not limited to showerheads, handshowers and bodysprayers.

The maximum flow rate provisions apply to the total amount of water flow resulting from <u>each</u> valve supplying the individual shower enclosure regardless of the number of attached showerheads (or similar fixtures). For example, if only one water line or valve supplies a shower enclosure or space, the maximum amount of resulting water flow, regardless of the number of showerheads, is 2 gpm @ 80 psi. If two separate valves provide water to separate showerheads, the maximum flow for <u>each</u> valve would be 2 gpm @ 80 psi. If the operation of two showerheads, controlled by one valve, results in more than 2 gpm @ 80 psi total water flow, then only one showerhead may operate at one time.

An exception to Section 4.303.2 provides for the maximum water flow rate, as allowed by the California Plumbing Code, to be at 2.5 gpm @ 80 psi. However, this flow rate is <u>only</u> allowed when using the "performance method" for 20 percent reduction for indoor water use.

4.408 Construction waste reduction, disposal and recycling

– New option: Waste management company

- New option: Waste stream reduction (4 lb/sq. ft.)

Exemption for isolated job sites was relocated

SECTION 4.408
CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.408.1 Construction waste management. Recycle and/or salvage for reuse a minimum of 50 percent of the nonhazardous construction and demolition waste in accordance with either Section 4.408.2, 4.408.3 or
4.408.4, or meet a more stringent local construction and demolition waste management ordinance.

Exceptions:
1. Excavated soil and land-clearing debris.
2. Alternate waste reduction methods developed by working with local agencies if diversion or recycle facilities capable of compliance with this item do not exist or are not located reasonably close to the jobsite.
3. The enforcing agency may make exceptions to the requirements of this section when isolated jobsites are located in areas beyond the haul boundaries of the diversion facility.

COMMENTARY

Purpose:
Construction waste diverted from landfills will help reduce landfill production of methane gas, a direct greenhouse gas. In addition, reusing and recycling materials typically results in less energy use than producing materials from virgin materials; conservation of the original resources and reduces the burden on landfills.

Background:
Where a local jurisdiction has not adopted a greater than 50 percent waste reduction requirement, the mandatory 50 percent waste reduction established in Section 4.408.1 applies. Section 4.408 also provides choices for meeting the waste reduction requirement including alternate waste reduction methods developed in consultation with local agencies. An exception also recognizes that waste facilities may not exist, or be reasonably close to the jobsite, making compliance with the literal requirements and the benefits intended by this section unfeasible. Determination of "reasonably close" will vary by jurisdiction according to the location of a jobsite and the nearest waste/diversion facility or whether the type of waste in question is accepted at the facility. In addition, construction waste reduction, disposal and recycling services may be economically impracticable or unavailable in some areas.

Local agencies can employ the use of a variety of strategies; through public and private sector recycling facilities to achieve state mandated waste reduction and recycling goals. Local agencies should be contacted prior to construction to obtain a list of approved waste haulers. The Department of Resources Recycling and Recovery (CalRecycle) also maintains a C & D (construction and demolition) Recyclers Database listing recycling facilities. Any successful recycling program will involve upfront due diligence, planning and the consideration of several factors. Many of these factors include, but are not limited to:

- *Local authority approved waste hauler*
- *Consideration of distance from the site to the recycling facility*
- *Method of recycling: on-site sorting (source separation) or bulk mixed (single stream)*
- *Recyclers with a reliable/verifiable performance record*
- *Clearly marked bins*
- *Routinely checked bins for material accuracy*
- *All involved parties are on board/buy-in*
- *"Load Tags" or "Trip Tickets" are collected and recorded*

Definitions for "Hazardous waste," "Recycle or Recycling," and "Re-use" are located in CALGreen Chapter 2, Section 202. Section 4.408 also supports legal requirements for local jurisdictions to divert 50 percent of solid waste through source reduction, recycling, and composting activities as required in Public Resources Code Section 41780.

4.504 Pollutant control – Carpet systems.

Change to referenced standards

The regulatory text for Sections 4.504.3 and 4.504.3.1 was amended in July 2011 and is effective July 1, 2012

4.504.3 Carpet systems. All carpet installed in the building interior shall meet the testing and product requirements of one of the following:

1. Carpet and Rug Institute's Green Label Plus Program.
2. California Department of Public Health, "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Version 1.1, February 2010 (also known as Specification 01350.)
3. NSF/ANSI 140 at the Gold level.
4. Scientific Certifications Systems Indoor Advantage™ Gold.

4.504.3.1 Carpet cushion. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute's Green Label program.

4.504.3.2 Carpet adhesive. All carpet adhesive shall meet the requirements of Table 4.504.1.

COMMENTARY

Examples of Acceptable Methods of Implementation and/or Compliance:
Builders should be ready to provide verification of compliance with any portion of this section to the enforcing agency. Compliance information is readily available online and should be accessible if required by an enforcing agency.

It is recommended that a method of compliance be ready and prepared so inspections are not failed or postponed because compliance materials are not available.

- *Product specifications should be easily accessible from the product and material suppliers. Make these available at time of inspection.*
- *Contractors should be cognizant that field inspectors can request to field verify that applied products meet the requirements of Section 4.504.3. It is suggested that contractors keep available any containers and/or product labels for inspectors verification until such time the inspector deems they are not required.*

- *Hyperlinks to supporting sample documentation forms are included in Chapter 8. These forms may be used for documenting VOCs and formaldehyde content in adhesives, paints and coatings, flooring and composite wood products used in the structure. These forms should be supplemented by product labels, specifications, Material Safety Data Sheets, evidence of certifications, or other means acceptable to the local enforcing agency. These forms are samples and may be modified by the user as needed.*

Background:
All carpet systems, cushions, and adhesives are required to comply with the VOC requirements set forth by Sections 4.504.3, 4.504.3.1 and 4.504.3.2, respectively. This practice will help reduce indoor emission levels thereby improving the overall healthfulness of indoor and outdoor air quality. Installed products used are third party-certified and installed in a manner acceptable to the manufacturer's requirements.

***Note**: All website addresses, especially those that are document-specific, may change over time. If there is a problem with accessing specific websites, the needed information may be found by typing in the most basic website address for the organization (e.g., www.carpet-rug.org), and then searching for keywords, such as "NSF".*

– Resilient flooring systems.
Change to referenced standards

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.504.4 Resilient flooring systems. Where resilient flooring is installed, at least 50 percent of floor area receiving resilient flooring shall comply with one or more of the following:

1. VOC emission limits defined in the Collaborative for High Performance Schools (CHPS) High Performance Products Database.
2. Products compliant with CHPS criteria certified under the Greenguard Children & Schools program.
3. Certification under the Resilient Floor Covering Institute (RFCI) FloorScore program.
4. Meet the California Department of Public Health, "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Version 1.1, February 2010 (also known as Specification 01350.)

COMMENTARY

Purpose:
This section adopts VOC limits for interior resilient flooring based on the Collaborative for High Performance Schools (CHPS) Low-emitting Materials List, Resilient Floor Covering Institute (RFCI) FloorScore program, and other acceptable standards. Compliance with these VOC limits will help

improve indoor and outdoor air quality and reduce occupants' exposure to chemicals that can have adverse effects on human health at higher levels.

Examples of Acceptable Methods of Implementation and/or Compliance:

- *50 percent or more of the total area of resilient flooring is VOC-emissions compliant.*
- *Flooring and adhesives that meet the VOC limits defined by CHPS for low-emitting materials in their High Performance Products Database.*
- *Products compliant with CHPS criteria under the Greenguard Children and Schools Program.*
- *Flooring certified under RFCI's FloorScore program.*
- *Products meeting specifications of the California Department of Public Health, "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers", Version 1.1, February 2010 (also known as Specification 01350.)*
- *Provide documentation of product certification and compliance.*
- *Hyperlinks to supporting sample documentation forms are included in Chapter 8. These forms may be used for documenting VOCs and formaldehyde content in adhesives, paints and coatings, flooring and composite wood products used in the structure. These forms should be supplemented by product labels, specifications, Material Safety Data Sheets, evidence of certifications, or other means acceptable to the local enforcing agency. These forms are samples and may be modified by the user as needed.*

Background:

Resilient flooring is commonly used in kitchens, bathrooms, entryways, family rooms and in other areas. These systems are commonly made from materials such as cork, vinyl, linoleum and rubber. Resilient flooring provides users a standing surface with "give" or "bounce back". In some instances, the ability for the material to be resistant to stains and microbial contamination make it a logical choice for use in homes.

4.505.3 Moisture content of building materials

Allows equivalent moisture verification methods as approved by AHJ

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.505.3 Moisture content of building materials. Building materials with visible signs of water damage shall not be installed. Wall and floor framing shall not be enclosed when the framing members exceed 19 percent moisture content. Moisture content shall be verified in compliance with the following:

1. Moisture content shall be determined with either a probe-type or a contact-type moisture meter.
   Equivalent moisture verification methods may be approved by the enforcing agency and shall satisfy requirements found in Section 101.8 of this code.
2. Moisture readings shall be taken at a point 2 feet (610 mm) to 4 feet (1219 mm) from the grade stamped end of each piece to be verified.
3. At least three random moisture readings shall be performed on wall and floor framing with documentation acceptable to the enforcing agency provided at the time of approval to enclose the wall and floor framing.

Insulation products which are visibly wet or have a high moisture content shall be replaced or allowed to dry prior to enclosure in wall or floor cavities. Wet-applied

insulation products shall follow the manufacturers' drying recommendations prior to enclosure.

COMMENTARY

Purpose:
The purpose of this section is to provide additional protection against growth of mold or other biological growth in moist enclosed areas. This section requires field verification of moisture content and prevents enclosure of wood framing members exceeding 19 percent moisture content. This section also prevents the enclosure and use of wet or moist insulation products.

Examples of Acceptable Methods of Implementation and/or Compliance:
- *Cover building materials to protect from rain and moisture.*
- *Ensure building is weather-tight before insulating.*
- *Use other precautions necessary to ensure building materials are kept dry.*
- *Test for moisture levels of building materials.*
- *Moisture sensors are available for purchase and range from $80 to $200.*
- *To comply with the requirements of this section, moisture readings must be properly taken and recorded and made available for review by the enforcing agency. The code also allows equivalent methods of moisture verification as allowed by the local enforcing agency.*

Background:
Wood construction is the most commonly used form of building construction in single-family and multi-family homes today. Freshly cut wood often displays moisture content levels of 30 percent and higher. Levels of this magnitude, especially when enclosed and prevented from drying, could cause serious problems with constructability as well as long-term building and occupant health.

Commonly used by building inspectors as a criteria for serviceability and performance of wood products; the maximum allowable 19 percent moisture level is the performance threshold for kiln-drying for many building codes. Section 4.505.3 details the requirements and methods to insure that the supplied building materials are safe for installation.

4.506.1 Bathroom exhaust fans.

Humidity control maybe a separate component ∞

SECTION 4.506
INDOOR AIR QUALITY AND EXHAUST

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.506.1 Bathroom exhaust fans. Each bathroom shall be mechanically ventilated and shall comply with the following:

1. Fans shall be ENERGY STAR compliant and be ducted to terminate outside the building.

2. Unless functioning as a component of a whole house ventilation system, fans must be controlled by a humidity control.

   a. Humidity controls shall be capable of adjustment between a relative humidity range of ≤ 50 percent to a maximum of 80 percent. A humidity control may utilize manual or automatic means of adjustment.

   b. A humidity control may be a separate component to the exhaust fan and is not required to be integral (i.e., built-in).

Notes:
1. For the purposes of this section, a bathroom is a room which contains a bathtub, shower, or tub/shower combination.
2. Lighting integral to bathroom exhaust fans shall comply with the *California Energy Code*.

COMMENTARY

Purpose:

The functions of a bathroom exhaust fan are to exhaust odors and excess humidity. This mandatory measure is intended to reduce moisture inside the residence through use of bathroom exhaust fans controlled by humidity sensing devices.

Examples of Acceptable Methods of Implementation and/or Compliance:

- *Install ENERGY STAR fans with humidity controls in each bathroom. Humidity controls for exhaust fans may be integrated in (built-in) or external to the exhaust fan units. Manual or automatic controls capable of adjusting for relative humidity of less than 50% are acceptable. The maximum relative humidity setting allowed is 80 percent.*
- *Install a fan in compliance with ASHRAE 62.2 "Ventilation and Acceptable Indoor Air quality in Low-Rise Residential Buildings" and Title 24, Part 6, in the bathroom that is a part of a whole house ventilation system.*

Background:

Excess moisture in the interior areas of buildings can lead to condensation, which promotes the growth of mold and may cause structural problems such as dry rot, warping of wood, etc.

Humidistats are sensors detecting the amount of moisture in the air. Humidistats can also be used as controllers to switch fans on or off when moisture levels exceed a designated range. Humidity control devices allow the humidity settings to be adjustable from 20 to 80 percent relative humidity and may be an integral component of the fan or may be external to the fan. Humidity controls for bathroom exhaust fans ensure that fans continue to run until moisture levels

in the bathroom fall to desired levels depending on local conditions and personal comfort levels. Often this may be more than 20 minutes after the bathroom is vacated.

ENERGY STAR states that "Qualified ventilation fans use 70 percent less energy than standard models. These fans provide better efficiency and comfort with less noise, and use high performance motors that work better and last longer than motors used in conventional models. They feature high performance motors and improved blade design, providing better performance and longer life."

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.504.1 Covering of duct openings and protection of mechanical equipment during construction. At the time of rough installation, during storage on the construction site and until final startup of the heating, cooling and ventilating equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheetmetal or other methods acceptable to the enforcing agency to reduce the amount of water, dust and debris, which may enter the system.

COMMENTARY

Purpose:
This section provides protection for duct openings, permanent mechanical equipment and other components which are often used for conditioning and ventilating during construction. Protection would result in reduced recirculation of construction dust, debris and other airborne contaminants upon occupancy, reduce moisture and water intrusion, and increase operating efficiency.

Examples of Acceptable Methods of Implementation and/or Compliance:

- *Several methods of protection are acceptable ranging from supply boots to cardboard and duct tape to specially designed rolled sheeting. Protection should have sufficient strength and be securely fastened to provide protection during the timeframe needed.*
- *Equipment, ducting, and plenums should be protected in a method that the protection is successful during the entire construction process.*
- *Equipment stored on the construction site for future installation should be wrapped or protected.*
- *It is recommended that the system not be operated when airborne contaminants are present. However, if the system is operated during construction, then it is recommended that a high efficiency filter such as a MERV 6 or 8, suitable for system capacity, be used throughout the*

construction process and the system be protected after each use. If the system is used prior to final start-up, it is recommended that the entire system, including ductwork, furnace and coil, be thoroughly cleaned and inspected to remove any construction-related particles.

- *Consider use of alternate space conditioning systems during construction.*

<u>Background</u>:

Pollutants caused from construction activities are of major concern as they migrate to the duct systems and air-handling units. Both visible and invisible pollutants can greatly affect indoor air quality when distributed throughout the dwelling by a forced air system. Dust, dirt, and airborne particles can substantially reduce the efficiency and operation of coils and compressors. This practice encourages and provides a method of protection to ensure that the long term mechanical efficiency and occupant health is not adversely affected by construction pollution

The regulatory text for this section was amended in July 2011 and is effective July 1, 2012

4.507.2 Heating and air-conditioning system design. Heating and air-conditioning systems shall be sized, designed and have their equipment selected using the following methods:

1. The heat loss and heat gain is established according to ANSI/ACCA 2 Manual J – 2004 (*Residential Load Calculation*), ASHRAE handbooks or other equivalent design software or methods.
2. Duct systems are sized according to ANSI/ACCA 1 Manual D – 2009 (*Residential Duct Systems*), ASHRAE handbooks or other equivalent design software or methods.
3. Select heating and cooling equipment according to ANSI/ACCA 3 Manual S – 2004 (*Residential Equipment Selection*) or other equivalent design software or methods.

Exception: Use of alternate design temperatures necessary to ensure the systems function are acceptable.

COMMENTARY

Purpose:
Section 405.7.2 requires HVAC systems to be appropriately sized to the heating and cooling loads (heat gain/heat loss) of the structure. This section also provides an exception to allow use of appropriate design temperatures reflecting design needs of buildings instead of broad-based climate information.

Examples of Acceptable Methods of Implementation and/or Compliance:

- *Heat loss and heat gain calculation using software (available on the Internet) or hand calculations or an equivalent.*
- *Duct system design to ensure adequate air flow is provided to address the heat loss and gain in each area of the home.*
- *Select equipment which will provide the necessary air flow and level of conditioning to satisfy the loads, function within the duct design criteria and within the equipment limitations.*
- *The referenced ACCA manuals are available from:*
  Air Conditioning Contractors of America
  2800 Shirlington Road, Suite 300
  Arlington, VA 22206
  www.acca.org
- *Use of design temperatures consistent with the California Energy Commission's Reference Appendices for the 2008 Building Energy Efficiency Standards for Residential and*

Nonresidential Buildings or a successor document.

Background:
The Air Conditioning Contractors of America's (ACCA) technical manuals include procedures and calculations used by designers, installers and technicians with the objective of creating heating, ventilation, air conditioning and refrigeration systems that meet code requirements and ensure customer comfort.

ANSI/ACCA 2 Manual J, Residential Load Calculation: *Produces equipment sizing loads for single-family-detached homes, small multi-unit structures, condominiums, town houses and manufactured homes.*

ANSI/ACCA 1 Manual D, Residential Duct Systems*: This is a comprehensive guide outlining the methods and procedures used to design residential duct systems.*

ANSI/ACCA 3 Manual S, Residential Equipment Selection: *Shows how to select and size heating and cooling equipment to meet Manual J loads based on local climate and ambient conditions at the building site.*

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) handbooks consist of a series of four volumes titled HVAC Applications, Refrigeration, Fundamentals, and HVAC Systems and Equipment. The handbooks are available from the ASHRAE Bookstore at www.techstreet.com.

The following forms are available for downloading from HCD's website under the heading "Compliance Forms and Worksheets." Individual links are also provided for each of the forms in both PDF; or Microsoft Word or Excel formats. Forms that appear in "read only" format may be downloaded and saved to another file name to enable editing.

The forms marked with an **asterisk (*)** are new forms. The forms marked with a **plus sign (+)** have been expanded and/or reflect amendments to the 2010 CALGreen adopted during the annual code adoption cycle and effective July 1, 2012.

Water Use Calculation Forms (Section 4.303)

- Worksheet (WS 1) – Baseline Water Use Calculation Table+
  - http://www.hcd.ca.gov/codes/calgreen/WS-1.pdf
  - http://www.hcd.ca.gov/codes/calgreen/WS-1.docx

- Worksheet (WS 2) – 20 Percent Reduction Water Use Calculation Table+
  - http://www.hcd.ca.gov/codes/calgreen/WS-2.pdf
  - http://www.hcd.ca.gov/codes/calgreen/WS-2.docx

Construction Waste Management Forms (Section 4.408)

- CW 1 – Construction Waste Management Plan (CWMP)+
  - http://www.hcd.ca.gov/codes/calgreen/CW-1.pdf
  - http://www.hcd.ca.gov/codes/calgreen/CW-1.docx

- CW 2 – Construction Waste Management Worksheet (Volume Method) and Instructions
  - http://www.hcd.ca.gov/codes/calgreen/CW-2.pdf
  - http://www.hcd.ca.gov/codes/calgreen/CW2.xls

- CW 3 – Construction Waste Management Worksheet (Weight Method) and Instructions+
  - http://www.hcd.ca.gov/codes/calgreen/CW-3.pdf
  - http://www.hcd.ca.gov/codes/calgreen/CW-3.xls

- CW 4 – Weight or Volume Summary Worksheet+
  - http://www.hcd.ca.gov/codes/calgreen/CW-4_WtVolSummary.pdf
  - http://www.hcd.ca.gov/codes/calgreen/CW-4_WtVolSummary.xls

- CW 5 – Construction Waste Management Worksheet (4 Lbs. per Sq. Ft.) and Instructions+
  - http://www.hcd.ca.gov/codes/calgreen/CW-5_4lbs.pdf

- http://www.hcd.ca.gov/codes/calgreen/CW-5_4LbsperSqFt.xls

- CW 6 – 4 Lbs. per Sq. Ft. Summary Worksheet+
  - http://www.hcd.ca.gov/codes/calgreen/CW-6_4lbSummary.pdf
  - http://www.hcd.ca.gov/codes/calgreen/CW-6_4LbSummaryWorksheet.xls

- CW 7 – Construction Waste Management Plan (CWMP) Acknowledgement+
  - http://www.hcd.ca.gov/codes/calgreen/CW-7_CWMPAcknowledgement.pdf
  - http://www.hcd.ca.gov/codes/calgreen/CW-7_CWMPAcknowledgement.xls

Building Maintenance and Operation Forms (Section 4.410)

- Operation and Maintenance Manual*
  - http://www.hcd.ca.gov/codes/calgreen/BldgOp_MaintenanceManual.pdf
  - http://www.hcd.ca.gov/codes/calgreen/BldgOp_MaintenanceManual.doc

Pollutant Control Forms (Section 4.504)

- PC 1 –Adhesives, Sealants and Caulks - Product Information*
  - http://www.hcd.ca.gov/codes/calgreen/PC1.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC1.xls

- PC 2 – Adhesives, Sealants and Caulks - Room/Location Matrix*
  - http://www.hcd.ca.gov/codes/calgreen/PC2.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC2.xls

- PC 3 – Adhesives, Sealants and Caulks - Declaration Statement*
  - http://www.hcd.ca.gov/codes/calgreen/PC3.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC3.xls

- PC 4 – Sample Worksheet*
  - http://www.hcd.ca.gov/codes/calgreen/PC4.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC4.xls

- PC 5 – Paints and Coatings - Product Information*
  - http://www.hcd.ca.gov/codes/calgreen/PC5.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC5.xls

- PC 6 – Paints and Coatings - Room/Location Matrix* o http://www.hcd.ca.gov/codes/calgreen/PC6.pdf o http://www.hcd.ca.gov/codes/calgreen/PC6.xls

- PC 7 – Paints and Coatings - Declaration Statement* o http://www.hcd.ca.gov/codes/calgreen/PC7.pdf o

http://www.hcd.ca.gov/codes/calgreen/PC7.xls

- PC 8 – Sample Worksheet*
  - http://www.hcd.ca.gov/codes/calgreen/PC8.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC8.xls

- PC 9 – Finish Flooring Materials - Product Information*
  - http://www.hcd.ca.gov/codes/calgreen/PC9.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC9.xls
-
- PC 10 – Finish Flooring Materials - Room/Location Matrix*
  - http://www.hcd.ca.gov/codes/calgreen/PC10.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC10.xls

- PC 11 – Finish Flooring Materials - Declaration Statement*
  - http://www.hcd.ca.gov/codes/calgreen/PC11.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC11.xls

- PC 12 – Sample Worksheet*
  - http://www.hcd.ca.gov/codes/calgreen/PC12.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC12.xls

- PC 13 – Composite Wood Products - Product Information*
  - http://www.hcd.ca.gov/codes/calgreen/PC13.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC13.xls

- PC 14 – Composite Wood Products - Room/Location Matrix*
  - http://www.hcd.ca.gov/codes/calgreen/PC14.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC14.xls

- PC 15 – Composite Wood Products - Declaration Statement*
  - http://www.hcd.ca.gov/codes/calgreen/PC15.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC15.xls

- PC 16 – Sample Worksheet*
  - http://www.hcd.ca.gov/codes/calgreen/PC16.pdf
  - http://www.hcd.ca.gov/codes/calgreen/PC16.xls

Documentation and Verification Forms (Section 703.1 and others)

- RMM 1 – Installation Certificate*
  - http://www.hcd.ca.gov/codes/calgreen/RMM_1.pdf
  - http://www.hcd.ca.gov/codes/calgreen/RMM_1.doc

Recycled Content Forms (Section A4.405.3)

- RCV Table 1 - Recycled Content Value Calculations*
  - http://www.hcd.ca.gov/codes/calgreen/Table1_RCVCalculations.pdf
  - http://www.hcd.ca.gov/codes/calgreen/Table1_RCVCalculations.xls
- RCV Table 2 - Assembly Product Recycled Content Calculations*
  - http://www.hcd.ca.gov/codes/calgreen/Table2_AssemblyCalculations.pdf
  - http://www.hcd.ca.gov/codes/calgreen/Table2_AssemblyCalculations.xls
- RCV Table 3 - Recycled Content Conversion Table (Pounds to %)*
  - http://www.hcd.ca.gov/codes/calgreen/Table3_ConversionTable.pdf
  - http://www.hcd.ca.gov/codes/calgreen/Table3_ConversionTable.xls
- RCV 4 - Recycled Content - Declaration Statement*
  - http://www.hcd.ca.gov/codes/calgreen/RCV_Table_4.pdf
  - http://www.hcd.ca.gov/codes/calgreen/RCV_Table_4.xlsx

Segments:

- **Introduction**

Minute 5

Part I: Core

- Definitions: IGS
- Stakeholders
- Correlation of IGS
- Investing
- Why Green?
- Investing in Green
- Questions on Green
- Sustainable
- "Perceived Green"
- Power of Persuasion
- Design Challenges
- Overall issues
- Components of Green
- Water
- Future Growth of Building
- Types of Examples
- This is the beginning
- Remember ...

- **Part II: Indexing Minute 30 to 40**

  Theory and Foundation of Indexing

  - **Marketing Value**
  - **Financial: Private, Government, Utility**
  - **Periodic Maintenance**
  - **Construction**
  - **Incidental Innovations**
  - **Human Behavior**
  - **Sustainability/Green Index**
  - **Greenerade Index, G_i**
  - **Metrics: 0 to 100 maximum**
  - **Sample Exercises**
  - **...**

- **Questions**

Minute 60-65

End

Minute 70

Introduction:

State of Sustainable Business

This discussion could have been presented from many angles:

- Owners,
- Property Managers,
- Investors, and
- Designers (Architects/Engineers).

However this gathering is basically engineers, only **Engineers point of view** will be addressed. It is important for engineers to fully understand the concept and the analysis.

The Engineer, as an advocate of the selecting a greener and sustainable infra-structure, steps are in designing and formulating the building, factory, the plant, etc..

Now the engineer must become:

1. master the art of persuasion- No pantomime,
2. comparative analysis,
3. an economist, and
4. a financial guru.
5. At the end of the day, an very good salesman.

This newly formed engineer must provide and persuade the end user with the **greenest design** and most **sustainable product** with **highest rate of return**.

This is the topic for today.

History:

The discussion of the ***word sustainable*** was only floating in the academic world and very few organizations a decade ago. The discussion was at infancy in the general public even 5 years ago. The very first time this country delved into the energy efficiency was after **oil embargo in 1973**. I graduated from Oklahoma City Western Heights high school right at that time and the price of gasoline was 0.25$ per gallon.

At that time all architects were working on passive and active energy building design. Scientific America and many architectural magazines were publishing articles.

I presented a paper at ASHRAE in solar water heating system in Oklahoma City. Government incentive programs filled the roof with solar water heating system, all buildings were getting insulated.

Afterwards where the energy crisis was no longer a crisis, the Humvees and large vans were in production, and companies were paying to take the solar water heating systems off of their roofs.

Few years ago, solar panels (water heating or PV) are getting installed on roofs. The solar panel companies began building a glut of the panels without any respect to its absorption rate by the general public. The PV solar panels were sold at $2.00 per watts and now it is $0.65 to 1.00 per watts. The economic culture could not sustain the glut of PV's. Hence, here is Solyndra's bankruptcy.

Since the incentive programs were eliminated or reduced and utility companies acted in monopoly and hindered efforts in creating solar farms. Please revert to one Saum's blog at Greenerade.com on Solar farms.

The gradual rise in cost of energy gave birth to presence on insulation in the housing and state of California adopted a **Department of Energy (DOE) Program** that resulted in **California Title -24**. The concept slowly crawled into other states and now the Comcheck, another DOE software child was given birth. This became a gateway to the energy efficient world, then Green, and finally sustainable world. **LEED concept from USGBC became a grand child of a program in United Kingdom from 1990's.**

LEED with its marketing apparatus shined over the engineering and design world and had a rapid growth.

State of California, ICC, UPC, all now have Green Codes.

- Definitions:
  - Investing $_{\text{Business}}$ (I)
  - Green (G)
  - Sustainable (S)

• Investing Business (I)

As Engineer, we all were trained in the world of Engineering Economy and a pillar of our work. In fact it is a main component of any professional engineering exam. A basic engineering problem was:
"Company X had two options in purchasing or procuring an instrument or machine.
Option I has one criteria and option II had a different criteria, say much more green or made the factory more sustainable. Given their present value, rate of interest rate, the amount of continuous maintenance, cost of labor, material used, and salvage value of the product at end of its life, and n number of years of life, which product will be the best and its rate of return to factory. One can ignore the green or sustainability and only look at the dollars and cents and evaluate its impact to the chief financial officer or the chief bean counter."
A pure business person, the economics of the product is whether the company had the initial capital, and what is the retate of return of the product without any respect to all other parameters.

Symbol	Meaning	Amount (in example)
P	Present Value of equipment right now	$1,000,000
A	Annual Value (What the money is worth in annual payments)	$50,000
F	Final Value of equipment at some future date- based on current value	$2,000,000
i	Interest, rate of money growth with time per time	5%
n	Number of years, duration of investment	5 years

Salvage value is when the property is discarded or decommissioned.

	Find	From	Discrete Payments, Discrete Compounding	Discrete Payments, Continuous Compounding	Continuous Payments, Continuous Compounding
Single Payment	F	P	$F = P(1+i)^n$	$F = Pe^{rn}$	$F = Pe^{rn}$
	P	F	$P = F/(1+i)^n$	$P = F/e^{rn}$	$P = F/e^{rn}$
Equal-Payment Series	F	A	$F = A\left[\frac{(1+i)^n - 1}{i}\right]$	$F = A\left[\frac{e^{rn} - 1}{e^r - 1}\right]$	$F = \bar{A}\left[\frac{e^{rn} - 1}{e - 1}\right]$
	A	F	$A = F\left[\frac{i}{(1+i)^n - 1}\right]$	$A = F\left[\frac{e^r - 1}{e^{rn} - 1}\right]$	$\bar{A} = F\left[\frac{e^r - }{e^{rn} - 1}\right]$
	P	A	$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$	$P = A\left[\frac{1-e^{rn}}{e^r - 1}\right]$	$P = \bar{A}\left[\frac{e^{rn} - 1}{ne^{rn}}\right]$
	A	P	$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$	$A = P\left[\frac{e^r - 1}{1-e^{rn}}\right]$	$\bar{A} = P\left[\frac{ne^{rn}}{e^{rn} - 1}\right]$
Gradient Series	A	G	$A = G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right]$	$A = G\left[\frac{1}{e^r - 1} - \frac{n}{e^{rn} - 1}\right]$	
	P	F_i	$P = \frac{F_1}{1+g}\left[\frac{(1+g)^n - 1}{g(1+g)^n}\right]$		

Green

Other than representing a color, it purely defines and correlates to earth and enhancing the life of the earth.

The gloom and doom theory of earth is very clear.

Gloom & Doom Factoids

- *Buildings in the U.S. consume more than 30% of our total energy and 60% of our electricity annually.*
- *Buildings consume 5 billion gallons of potable water per day to flush toilets. (12% of the water consumption)*
- *136 million tons of construction and demolition debris - annually about 40% of the total U.S. solid waste stream of roughly 2.5 lbs. of solid waste per square foot of floor space for construction of a typical commercial building*
- *Studies of workers in green buildings reported productivity gains of up to 16%.*
- *About ¼ of the increase in carbon dioxide is due to the building sector, Energy efficiency may reduce this by 50%.*
- *Buildings consume 40% of raw stone, gravel and sand, and 25% of virgin wood.*

- *35% of U.S. carbon dioxide emissions (a greenhouse gas)*
- *It's estimated that U.S. businesses lose 60 to 400 billion dollars annually as a result of building-related illnesses.*

The average American spends 90% of their time indoors, so the potential for buildings to either adversely affect or positively support human health and productivity in the U.S. is therefore significant."

Factoids by LEED Category

Sustainable Sites

- Vehicles are responsible for approximately *20% of U.S. greenhouse gases* annually.

Water Efficiency

- *340 billion gallons* of fresh water are withdrawn per day from rivers, streams, and reservoirs to support residential, commercial, industrial, agricultural, and recreational activities.
- Almost *65%* of water taken is discharged back to bodies of water after use.
- Annual *water deficiency for the US is 3,700 billion gallons*.
- US industries today use *36% less water than in 1950* due to reuse and Energy Policy Act of 1992 mandating water conserving plumbing.
- Water consumption rose *6 fold* in the last century – double the rate of population.

Energy & Atmosphere

- *Coal-fired electric utilities* produce almost *1/3* the total emission of nitrogen oxide by US citizens.
- Fundamental commissioning can increase building energy efficiency from *5-10%*.
- Buildings with M&V programs save *10 to 20%* the electricity of buildings without.
- "Lost Productivity" is equated with *20% of occupants complaining 30 minutes per month*.
- Occupancy sensors may save up to *60%* of light energy costs in a building.

Materials & Resources

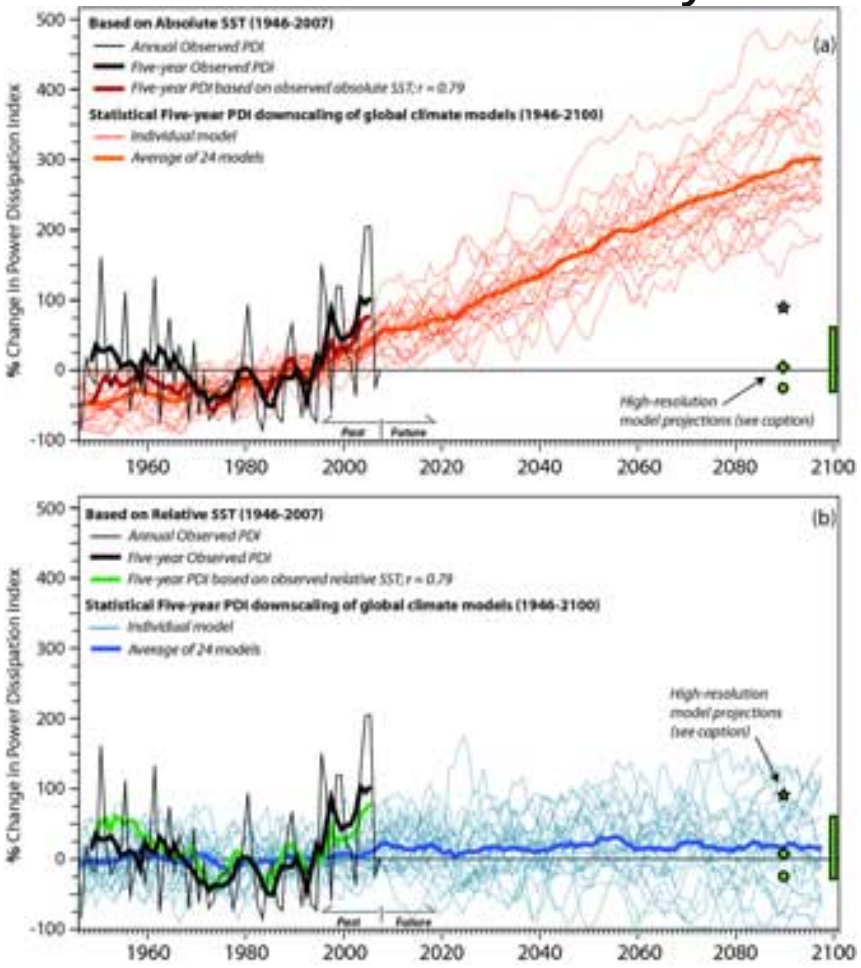
- *4%* of US old growth forest remains.
- *20%* of the world's large ancient forests remain intact.
- *90%* of residential construction is wood.
- *40%* of the waste stream is due to construction and demolition.
- Recycling an aluminum can uses *5%* of the energy needed to create a new can out of virgin mined aluminum.

Indoor Environmental Quality

- A well-designed daylight building is estimated to reduce energy use by *50% to 80%*.

Others:
The icebergs, Ganges River Nepal, Commercial Trips to North Pole, the countries now are staking the warm waters of the North pole, Ice Cities in Alaska vanishing, migration of birds, sharks near beaches, lost whales, increase in temperature of water in Peru and its effect in Oklahoma City, the hurricane levels.

Observed records of Atlantic hurricane activity: Local tropical Atlantic sea surface temperatures (SSTs) the Power Dissipation Index (PDI) PDI is an aggregate measure of Atlantic hurricane activity



The Fujita Scale

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in fores uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-inforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

Date	Location	Death Toll	Path Length
4-May-07	Greensburg, Kansas [8]	11	26 miles
25-May-08	Parkersburg - New Hartford, Iowa [9]	9	43 miles
27-Apr-11	Philadelphia, Mississippi [10]	3	29 miles
27-Apr-11	Hackleburg, AL - Huntland, TN [11]	72	132 miles
27-Apr-11	Smithville, MS - Shottsville, AL[12]	23	75 miles
27-Apr-11	Rainsville, Alabama [13]	25	33.8 miles
22-May-11	Joplin, Missouri [14]	158	22.1 miles
24-May-11	Calumet - El Reno - Guthrie, Oklahoma [16]	9	65 miles

California fires in the past 30 years have gone from one 100,000 acre fire to twenty and minimum one 500,000 acre annually.

Recent fires and drought in 2012 has provided thousands of weather records for the century.

In short, the Green indicates that the materials used will have the least impact on resources of the earth and global impact.

Sustainability:

An absolutely misused word.

The simplest meaning of the sustainability is to **prolong the life of the equipment or building so that the unit will not be trashed and increase the landfill**. The original equipment was made by earth resources, the longer the unit functions, more sustainable unit becomes.

The sustainable does not necessarily equate to cheaper, or greener product. All of the fortune 500 are contemplating with this word. And now there are schools who are pushing this issue.

Sustainable MBA programs

- Aarhus School of Business, Aarhus University offers a Sustainable MBA option.
- Albers School of Business & Economic, Seattle University offers a Sustainability Specialization as part of their MBA program.
- Anaheim University offers an online Green MBA degree option.
- Antioch University New England offers an MBA in Sustainability degree.
- Bainbridge Graduate Institute offers an MBA in Sustainable Business, an MBA in Sustainable Systems: certificates
- Brandeis International Business School, Brandeis University offers a Global Green MBA.
- W.P. Carey School of Business, Arizona State University offers an emphasis in Sustainability as part of their MBA program.
- Clark University offers an MBA in Sustainability
- Colorado State University offers an MBA in Global & Sustainable Enterprise.
- Dominican University of California offers an MBA in Sustainable Enterprise.
- Doshisha Business School,Doshisha University offers a Green MBA certificate/Sustainability focus
- Duquesne University offers a MBA Sustainability degree.
- Golden Gate University offers a concentration option in Managing for Sustainability as part of their MBA program.
- Green Mountain College offers a Sustainable MBA option.
- Haas School of Business, UC Berkeley offers a concentration in Corporate Social Responsibility to its MBA students.
- INCAE Business School offers a concentration in Sustainable Development to its MBA students.
- Johnson Graduate School of Management, Cornell University a concentration and an immersion in Sustainable Global Enterprise.
- Marlboro College Graduate School offers an MBA in Managing for Sustainability.
- Marylhurst University- offers an MBA in Sustainable Business.
- MIT Sloan School of Management offers a Sustainability Certificate for MBA and related masters programs.
- Presidio Graduate School, Alliant International University offers an MBA in Sustainable Management degree.
- San Francisco State University's College of Business offers an emphasis in Sustainable Business as part of their MBA program.
- Schulich's School of Business offers a specialization in sustainability as part of their MBA program.
- Tepper School of Business, Carnegie Mellon University: concentration in Ethics and Social Responsibility to its MBA students.
- Norwich Business School, University of East Anglia offers an MBA in Strategic Carbon Management
- University of Exeter - offers a One Planet MBA.
- University of Michigan Ross School of Business - dual degree program

- **Stakeholders**
- Engineers/Designers
- Owners, Corporate Companies, Governments, ...
- Environmentalists, (tree huggers?), ...

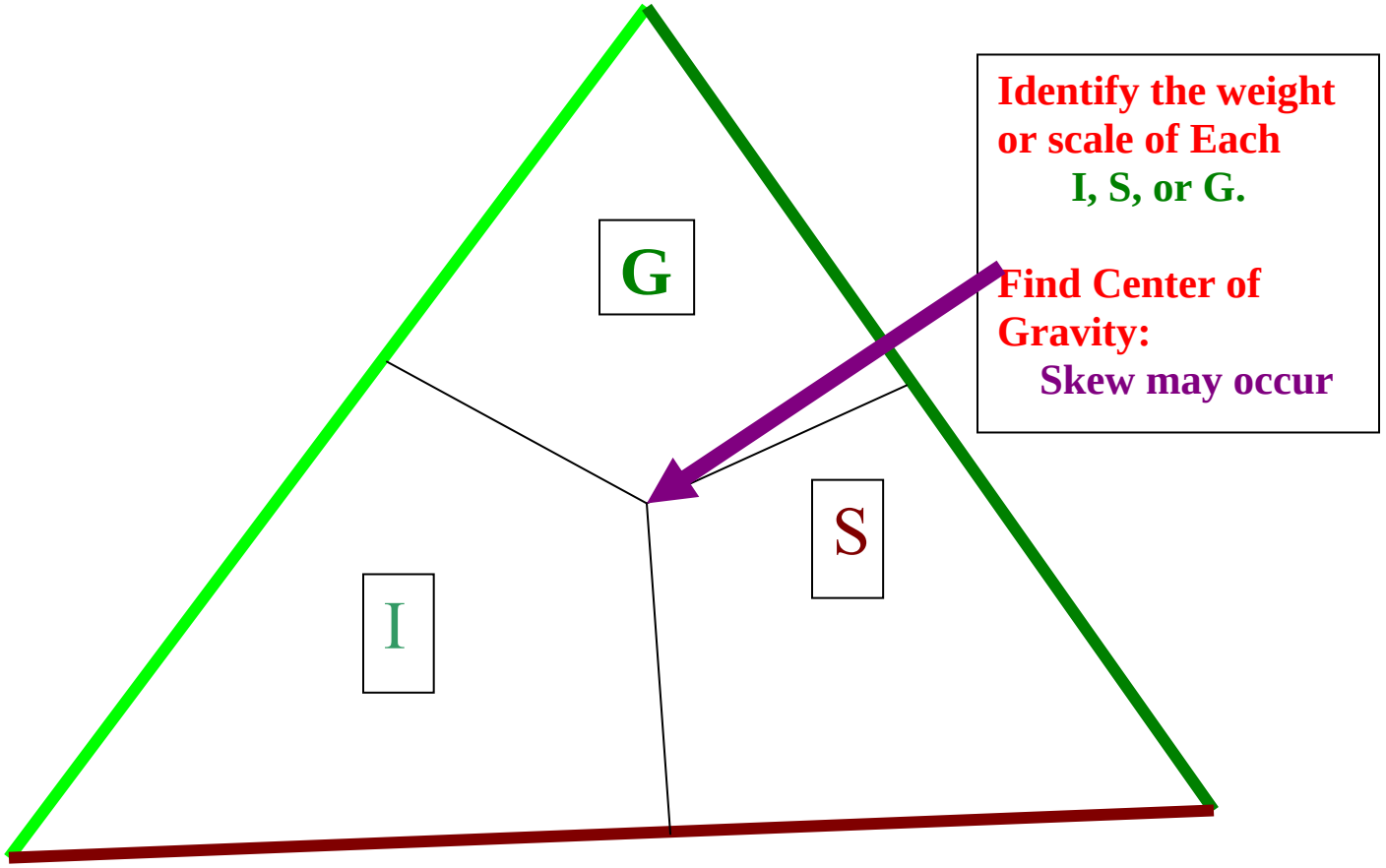
Psychology of individuals

- Engineers/Codes and Ethics
- Finance/Business
- Green/Sustainable
- Environmentalist

C. Correlation of I.G.S.

- Triangulation of IGS
- Three masses?
- Where is the Center Of Mass (COM) for IGS?
- The Tilt: Which corner carries more weight?

Triangulation of IGS:



- Investing
  - Decisions Among Choices
  - Engineering Economy
  - Graphical Comparison
  - Example of cost/benefit ratio

- Why Green?

Gloom and Doom issues... now, not tomorrow

Voluntary Versus

Mandatory (local governments, company policy)

One earth=One human=Scarcity of Materials

Economics of Sustainable design, management, ...

Renaissance: Resistance to change by existing

Natural change or resistive change...

Personnel training for change ....

- Original question:

Investing in Green:

A Business Approach to Sustainable Design

There are deeper concepts for Businesses:

- ROI on Greening the Business and
- Creating a Sustainable business Approach
- Investing in Green Funds

- Additional questions:

G/S: Green/Sustainable

- Going **G/S** in a Tough Economy
- The Value of Being **G/S**
- Do it with a **G/S** Team
- Politics of **G/S**
- Easy, Cost Effective Efforts for Small and Large Businesses
- Scalability of **G/S** initiatives
- In-House Guidance: Studies, Statistics, and Resources

More Questions

- Developing G/S Business Strategies
- Climate Strategy and Program Design of G/S
- Environmental Footprint and Reduction Strategies
- Documenting Results for the Public
- G/S the Supply Chain
- Conservation Finance and Facilitating Investments

Resistances and Mishaps in past for G/S business:

1. **No Clear standard** on measuring G/S
2. Government incentives **to correlate** with G/S.
3. Consumers **wavering** loyalty to G/S products
4. **No promotion** for staff to undertake G/S
5. **Disconnect** between G/S and business.
6. **No correlation** between G/S Opportunities and threats on the horizon.
7. **Too Much** G/S Show "Perception"
8. **Engaging** all parties in team and key stakeholders
9. **Create** References and rules for sourcing G/S
10. Many Early G/S Companies **losing their will**

- Top 50 "Perceived" Green Companies by Deloitte

- **Power of Persuasion**

Economics,
Marketing,
Environmentalist,
Sustainable, or
"just doing the good deed"

- Design Challenges

Buildings

Existing

Renovation

Alteration

New

Other Design Challenges

- Finance: Owners, Managers, Businessmen
- Own, Rent
- Private, Public
- Longevity

- Components of G/S:

Site,

Water,

Material,

Energy,

Indoor air quality

Water

$Water Commodity Stock Exchange$

Video

http://greenerade.com/

▪Future Growth of Buildings

- **Changing shapes and format**
- **Telecommunication/Internet changes in way of life and business**
- **71% of the Company Agendas are Sustainability**
- **Sustainability versus efficiency**
- **$6 Gasoline is near by= California**

Q. Examples:

- High efficient water heaters
- Variable Frequency Drives -Add Intelligence
- Low water consumption fixtures
- Lower velocity pipe design
- Incandescent versus LED
- High Efficiency Motors
- Instrumentation
- Measurement, verification, controls
- Commissioning
- Training
- Education
- …

▪ This is just the beginning

GSA's mandates.... a very good example of the future.

Rejoice: More companies will join?

Are you ready?

Can you persuade?

Are you savvy on Green & Sustainability?

Can you do the math?

Can you keep the non-engineer understand?

Can you adopt, adapt, and change?

S. Remember ...

Next **Earth-like planet** is

59 M light years **away**.

You cannot leave.

This is it.

Invest in Green:

Start a Business Approach to Sustainable Design.

Now!

Let's Do Examples

Indexing Green and Sustainability

Greenerade Index, G_i

Theory and Components of Greenerade Index:

The Chief Financial Officers continuously control the flow of money within organizations. Of course their goals are continuous operations of the organization with **minimal expenditures and maximum profit**.

A request for a green project must have a very persuasive discussion for a non-engineer, with only one goal in mind: **"The bottom Dollar".**

The task now becomes much more difficult.
An engineer is now is morphed into a **messenger**, a **profit**, a **persuader** that the request for a project, beyond the basic operating cost of the building is requested.

The Engineer is now **obligated to prove** the benefits of this mission.

How many ways can the engineer approach this:

A. Marketing
B. Financial Incentives: Government or Utility
C. Annual or periodic change of equipment due to age or failure
D. New Innovations in Construction
E. New Equipment Innovations- Gadget
F. Human Behavior

A. Marketing

The thirst for being known as green, an earth friendly environment, green planet, symbols of green or green banners across the original logos, etc. are now commonly seen throughout the companies across the country. Any green project that will provide additional advertising excuse is a viable project. It has to have an advertising value. **A major soft drink company has many of their trucks with the hydrogen fuel, and their banners are no longer, we are tasty ad good drink. they simply say, WE are green, we are not polluting**. Oil companies portray the nature, the little birds getting washed and very nice sounding music in the background to complement. The engineers task now is extended to advertising value. A digital water meter scale showing on the entrance wall of the corporation simply indicating, how many gallons of water being saved in the building. This can be fully benefit the plumbing engineers goal of adding meters and measuring throughout the building. A quarterly report on savings can be added to the web site of the building.

B. Financial Incentives: Government or Utility

To offset the initial capital there are number of incentive programs. These reduce the fear from the CFO's initial budget requirements. These incentives are easy picks for the engineers. Change out of all fixtures within buildings, modifications of light ballasts, installing vfd's that are interactive with use, the installation of high efficiency motors are all part of this package. mind you that the money paid out were the government induced program and the funds were allocated by earlier tax by all communities.

The reduction of water savings in a 55 story building for mere $15,000 cost is very appealing. Incentives pay for the rest. The sewer fees cost reduction plus lower water bill easily justifies these changes. Data will be shown below.

C. Annual or periodic change of equipment due to age or failure

This is also relatively simple. The cost of installation of product is comprised of equipment and labor. The labor cost is nearly the same for all equipments. The initial additional capital cost can be justified since it only may present a small percentage of total installation.

D. New Innovations in Construction

This becomes a challenge depending on the value of the difference. The value engineering by the contractors are sometimes self appeasing. During which, the actual cost benefits are never returned to the owners.

Example: A high efficiency water heater utilizing. This engineer introduced this product nearly 15 years ago to two chain restaurants and hotel chain. Previously, a boiler and tank were placed on 123 room motels on the roof of the building. One of the reasons was the flue duct. The introduction of four water heaters in tandem on the first floor was revolutionary. The very high efficiency simply was the first. The near 96% efficient water heater reduced the number of water heaters. The n+1 redundancy factor became second issue. The seismic and structural support of the system on the roof was non as easy task. Finally the PVC flue duct to penetrate on side of the building was icing on the cake and original reason. The cost savings based on the therms not wasted is extremely appealing to the CFO.

In chain restaurants, especially the in-line units, or non prototype layouts, the high efficiency water heaters is provides major flexibility for the placement of the water heater for the food service kitchen designer. The flexible pvc pipe can travel distances and is not restricted by the flue section of the plumbing codes.

E. New Equipment Innovations- Gadget

There are times that products are introduced into market that are out of sequence. Their only purpose is to penetrate the market with an innovative concept, and do not fall into regular categories, such as stated above.

The marketing of such products to CFO is not easy. Therefore much stronger narratives must be provided. These products are hidden, out of views, generally within the plant or roof, and cannot be advertised to the tenants or building occupants.

In one incidence, additional UV covers over all sun-exposed insulations is required a major energy analysis. Most insulation exposed to sun transform from thermoplastic to thermoset. They become brittle and break apart and loose their integrity. Additional protection or jacket can elongate the life of the predict, hence, its sustainability.
In persuasion of this product, although the btu savings was minor for each lengthy, easily added to a considerable magnitude in a 220 unit apartment settings.

F. Human Behavior

Feel good products are truly depends on the environment. The smoking ban and advertising that began two decades ago is a good example of this section. The advertising and the populous messaging has seriously modified the human behavior of this issue. Now tobacco smoking ban within building is predominant nationwide. This concept can easily be adopted and transferred into green world. The ban on plastic bags is quite obvious in many towns. Turning off lights, or the faucets or minimal use of water in house hold goods, use of water saving equipment, energy star appliance are part of the same group.

H. *Gi*, *Greenerade Index*:

A new metric, gauge, scale in pursuing the Green, Investment, and Sustainability.

Center of Mass, C.O.M.

Gi, *Greenerade Index*

How do you measure the effectiveness of your request:

Use Greenerade Index

The parameters effecting this are:'

1. Marketing M
2. Financial, F
3. Sustainability, S
4. Human Behavior, H
5. Green level or associated codes (Cal Green, LEED, IGCC), G

Values of A=F=S=H=G = maximum 20

The values range from zero to 20. In each case, the value of zero is dedicated for absolutely no value to the company, factory, building to maximum possible benefit in that category.

A normal minimum efficient water heater has Green value (G) of zero and in case of 98% efficient will receive value of 20. The values of M, F, S, H, and G are set and provided by the industries available efficiencies and data.

A set of weight factor, namely, w is provided to customize and vary the main parameter values for each manufacturer, building, or plants. Values of w ranges from 0 to 5. If marketing department believes the choice selected will be highly effective in an marketing, w_m will be equal to 5. If the building is pursuing LEED, then use of the green product will receive w_G of 0 to 5 for maximum available points.

Total value of the weight factors cannot exceed 5. Therefore the engineer must be able to identify the weight factor of each components with respect to others.

w_M, w_F, w_G, w_H, w_S = 0 to 5

$w_M + w_F + w_G + w_H + w_S$ = Maximum 5

Gi=

$M^* w_M + F^* w_F + S^*. w_S + H * w_H + G * w_G$ =

Zero to 100

LHF's or Low hanging fruits refer to financially very small value to the entire project.

w_x = 4 to 5

Value of Greenerade Index between options must be compared and automatically considered.

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	$M^* w_M$ =	0
W_s =	0	S =	0	$S^* w_S$ =	0
W_H =	0	H =	0	$H^* w_H$ =	0
W_F =	0	F =	0	$F^* w_F$ =	0
W_G =	0	G=	0	$G^* w_G$ =	0
Sum	0				0

Gi= 100

Examples of investing in green are several:

1. Replacing Existing Plumbing Fixtures with High Efficiency Fixtures
2. LEED EB:OM Analysis 55 story Building
3. Addition of the air flow sensors for outside air (OSA) intake
4. Installation of CO2 sensors.
5. Commissioning
6. To replace Existing Boilers and Isolate Water Heating Use from Steam System
7. Wrap additional sun proof insulation over exposed roof piping
8. Changing the method of installation. No sanding drywall Mud.
9. Remove Boiler on Roof with 5 high efficiency water heaters on first floor.

1. Replacing Existing Plumbing Fixtures with High Efficiency Fixtures

A 55 story building with two sets of restroom on each floor. The total of the plumbing fixtures is: 330 water closet, 330 Lavatories, and 165 Urinals.

The water closet consumptions reduced from 1.6 GPF to 1.1 GPF, the Urinals were reduced from 1 GPF to 0.125 GPF, and Lavatories was reduced from 2.5 gpm to 0.5 gpm. The interesting financial element to add is the incentives provided by local water purveyors adds a major likeliness of the investment in changing the fixtures.

The water savings and the cost savings are substantial, the final cost savings for water **$315,843 and over** 1290937.5 gallons of water saved. Combining with the sewer discharge rate reduction, the savings becomes greater than $534,000. Cost of installation after rebated to the Owners is a one time fee of $20,000. or $514,000 savings the first year, and $534,000 per annum ignoring any cost of sewer or water increase.

The environmental impact and financial savings are immense and can be enumerated:

A. Near $534,000 savings per year or added profit to the building owners for a one time initial coat of $20,000

B. All fixtures will be new and will carry the warranty, therefore all maintenance cost of existing older fixtures will be eliminated for one year.

C. With lower sewer flow rate, the probability of leakage, and the life expectancy of the piping will increase.

D. The reduction in flow rate increases the life expectancy of the copper piping, and hence reducing the velocity of the water within piping. This reduction reduces the erosion of the copper piping, and hence increasing the life of the copper piping.

E. For LEED Existing Building: Operations and Maintenance, the 46% water savings translates to 4 point

Source California Green Code July 1st 2012				Population	2500				
Existing Water Use									
Flush Valve Water Closet	1.6	1 flush	1	male	1250	Person=	2000		
Flush Valve Water Closet	1.6	1 flush	3	female	1250	Person=	6000		
Urinal	1	1 flush	2	male	1250	Person=	2500		
Lavatory (2.5 gpm flow rate)	0.25	0.25 min	3	male/female	2500	Person=	468.75		
								10968.75	GPD Total
New Water Use									
HET Flush Valve Water Closet	1.1	1 flush	1	male	1250	Person=	1375		
HET Flush Valve Water Closet	1.1	1 flush	3	female	1250	Person=	4125		
Urinal	0.125	1 flush	2	male	1250	Person=	312.5		
Lavatory (0.5 gpm flow rate)	0.05	0.25 min	3	male/female	2500	Person=	93.75		
								5906.25	GPD Total

Savings ratio	0.461538

Cost of Water DWP average	$3.27	per 100 cuft				
Savings	5062.5	GPD	1290937.5	Gallons annual		
Savings in Cuft	378.7763	100 cuft				
Cost Savings per Day	$1,238.60	(255 days/year- exclude holidays-weekends)		**Water**	**$315,843**	**Annual**
Sewer discharge Savings Cost						
Cost per 100 cuft sewer	$2.27	100 cuft				
Flow rate	378.7763	100 cuft				
Cost Savings per Day	$859.06	(255 days/year- exclude holidays-weekends)		**Sewer**	**$219,061**	**Annual**
			Total Savings		**$534,904**	**Annual**

$$Gi = M^* w_M + F^* w_F + S^*. w_S + H * w_H + G * w_G$$

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	$M^* w_M$ =	0
W_s =	0	S =	0	$S^* w_S$ =	0
W_H =	0	H =	0	$H^* w_H$ =	0
W_F =	4	F =	20	$F^* w_F$ =	80
W_G =	1	G=	0	$G^* w_G$ =	20
Sum	5				100

The Incentive program and the economics made this Gn index the maximum

Gi= 100

2. LEED EB:OM Analysis 55 story Building

Summary of LEED Credits based on Activities proposed:

List	Description	Credit	Points	Cost
A.	Installation of Water Meters...	WE1	2 Points	$15,000
B.	Installation of High Efficient Water Fixtures	WE2	4 Points	$50,000
C.	Installation of Flow Sensors, CO2 Sensors, Commissioning			
		EA1, 2.1, 2.2, 2.3, 3.1, 3.2, 6	10 Points	
		IEQ1.1, 1.2, 1.3, 1.4,1.5, 2.3	6 Points	
				$81,000

Number of Energy and Air components affecting LEED Existing Building: Operations and Maintenance

Energy and Atmosphere (EA)

Prerequisite 1 **Energy Efficiency Best Management Practices—**
Planning, Documentation, and Opportunity Assessment
Prerequisite 2 **Minimum Energy Efficiency Performance**
Credit 1 **Optimize Energy Efficiency Performance**
Credit 2.1 **Existing Building Commissioning—** **Investigation and Analysis**
Credit 2.2 **Existing Building Commissioning—** **Implementation**
Credit 2.3 **Existing Building Commissioning—** **Ongoing Commissioning**
Credit 3.1 **Performance Measurement—** **Building Automation System**
Credit 3.2 **Performance Measurement—** **System Level Metering**
Credit 6 **Emissions Reduction Reporting**

Indoor Environmental Quality

Prerequisite 1 Minimum Indoor air Quality Performance	
Credit 1.1 Indoor air Quality Best Management Practices—	**Indoor air**
Credit 1.2 Indoor air Quality Best Management Practices—	**Outdoor air**
Credit 1.3 Indoor air Quality Best Management Practices—	**increased Ventilation**
Credit 1.4 Indoor air Quality Best Management Practices—	**Reduce Particulates in air Distribution**
Credit 1.5 Indoor air Quality Best Management Practices—	**Indoor air Quality**
Credit 2.3 Occupant Comfort—	**Thermal comfort Monitoring**

Other Budgets requested:

Purchase of Green power (one to 6 points +possible 7th point based CO2 emission calculations) plus USGBC fees

$48,000.00

3. Addition of the air flow sensors for outside air (OSA) intake

To offset the environmental odor of the building (off-gassing) as well as habitants (CO2), the codes require a minimum cubic feet per minute of outside air. This fresh air is typically forced into the building and mixed with return air of the air conditioning systems. Continuous monitoring of the OSA is extremely beneficial.

As engineer and practitioner, we are aware of inaccuracies of building systems, the age effect, or hysteresis effect of instrumentations. On the other hand the presence Sick Building Syndrome as a foundation legal cases against building owners are well published in the industry. The lack of information on the level of outside air intake can itself be basis for a legal case. In addition, number of calls

from tenants on headaches, flues, odors, or similar issues can be correlated to the outdoor air.

Measurement and verification of building systems is additional requirement of controls. Introduction of outside air and real time information on the level of outdoor air intake leaves no room for errors or mishaps. The low level of outdoor air can send alarms to the facility manager to either verify the forced intake system or provide other measures to correct. The installation of outdoor air intake measurement will impact every pre-requisite as well as the credits shown in tabulated table.

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	M* w_M =	0
W_s =	0	S =	0	S* w_S =	0
W_H =	0	H =	0	H* w_H =	0
W_F =	0	F =	0	F* w_F =	0
W_G =	0	G=	0	G* w_G =	0
Sum	0				0

Gi= 100

4. Installation of CO2 sensors.

The CO2 level within one room beyond 800 PPM, will cause dizziness and will interrupt the persons ability to comprehend. Installation of CO2 sensors and measuring the CO2 level will provide adequate data for the system to increase the outside air intake to the room. The CO2 sensor becomes critical in areas of high occupancy ratio such as assembly areas, classrooms, or similar. The benefits of CO2 sensors are similar to outside air flow sensors, with high emphasis on legal issues that can be raised by occupants.

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	M* w_M =	0
W_s =	0	S =	0	S* w_S =	0
W_H =	0	H =	0	H* w_H =	0
W_F =	0	F =	0	F* w_F =	0
W_G =	0	G=	0	G* w_G =	0
Sum	0				0

Gi= 100

5. Commissioning

Benefits of commissioning within large commercial buildings are great. The main task of commissioning is to verify, validate, and correlate hundreds of data with networks of lighting, cooling, heating, ventilation and control systems. Variations in Commissioning (analysis, implementation, ongoing, ...) will result in identifying and solving problems in operation of large buildings: comfort complaints, missing or malfunctioning equipment, malfunctioning controls, unexpected equipment failures, and excessive energy costs.

LEED EB: OM has given importance to Commissioning with three separate credit requirements. Commissioning addresses errors, omissions and any discrepancies, next it verifies the equipment, and associated controls. Commissioning addresses training of personnel and better informing of facility managers. Finally, it addresses and creates protocols for normal, maintenance, as well as emergency situations.

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	$M^* w_M$ =	0
W_s =	0	S =	0	$S^* w_S$ =	0
W_H =	0	H =	0	$H^* w_H$ =	0
W_F =	0	F =	0	$F^* w_F$ =	0
W_G =	0	G=	0	$G^* w_G$ =	0
Sum	0				0

Gi= 100

6. To replace Existing Boilers and Isolate Water Heating Use from Steam System

A building contains three boilers @18,000,000 btu's generating steam at best 55% efficiency Boilers feed hot water via heat exchangers What are the Greenerade Index for exchanging the boilers with 87% efficient boilers and segregating the water heaters from the space with 97% efficient water heaters.

Existing Multi Building Campus was designed with three 18M Btu's Steam Boilers. Steam boilers satisfy the heating system as well as with using heat exchangers satisfy the hot water needs of the cumulative 55 story floors.

Proposal: Replace one of the boilers with multiple 87% (highest efficiency for steam boilers), and completely isolate the hot water system with multiple 96% minimum high efficient water heaters.

In the simple graph below, two remaining boilers are located in basement. Two sets of heat Exchangers also are in basement. One giving service to near 28 floors (T-Tower) and other feeding the 11 story building (S-Building). A third heat exchanger is near 240 ft horizontal and 11 story vertical height away on the roof of the adjacent building (N). Top floors of the T building has independent water heater giving service to the top three floors.

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	M* w_M =	0
W_s =	0	S =	0	S* w_S =	0
W_H =	0	H =	0	H* w_H =	0
W_F =	0	F =	0	F* w_F =	0
W_G =	0	G=	0	G* w_G =	0
Sum	0				0

Gi= 100

The 18 M Btu's steam boiler operates continuously through the entire year to service basic water heating and heating. The heating season in southern California in commercial office space is defined as few core winter months that will satisfy the "Morning-Chill-Out" period, 6:00 am to 10:00 am. Afterwards, the building internal heating, i.e. computers, lights, people, ... will satisfy the required heating. During the summer season, the only need is few showers (in Gym and 11th floor of the S building) and hand lavatories are the only heating requirements.

The Original boilers were only near 70% efficient, given the age, level of fouling factor within te heat exchangers, the efficiency is now below 50%. Combining the multitude of added maintenance cost for basic upkeep plus lack of staging or cascading of the energy use easily makes the

replacement of the units a very good candidate. In addition, in summer months, these units will be functioning for very small use of hot water heating. Specially, when hot water has to travel near 350 ft or near 700 ft of travel. The loss of heat through the piping can easily be accounted up to 5% to 15% from short to long distances, respectively.

Recommendation is very simple. A. Replace one of three units with three 4M Btu's boiler.

The current boilers at time of installation were worth:
18*0.70 = 12. 6 M Btu's
Estimated Current Worth is:
18*0.50 = 9.0 MBtu's

New three Boilers at 4 MBtu's are worth:
4*3*0.87 = 10.4 MBtu's

	Grade	Effectiveness Factor, Ef			
Wa=	0	A =	0	AWa=	0
Ws=	0	S =	0	SWs=	0
Wh=	0	H =	0	HWh=	0
Wf=	5	F =	20	FWf=	100
Wg=	1	G =	20	GWg=	20
					120

The Incentive program and the economics made this Gn index the maximum

(If more than 100) set at 100

Gi= 100

The cascading and multi staging of effects of boilers, external electronic controls within units reduces the heating cost based on intelligent demand use for all months except in case of very few days of extreme code. The second existing unit will act as back up for such events. Alternating the master - slave relationship among the three boilers will enhance and increase the life expectancy of all boilers. Please note that A) cascading within each unit, plus the presence of other units, insures that the minimum efforts by the boilers will be spent to satisfy the boiler needs of the building. This is in contrast to existing 16 M Btu furnace that must be on stand by for very minimum use at time of need.

In addition, the recommendation is to completely segregate the water heating. The point of use water heaters needs for lavatories and few showers. The recommendation is that, a) heat exchangers will be only a storage tank, hence reducing number of high efficient water heaters, b) use high efficient water heaters (98-99%) to offset the current boilers at near 50%, c) The travel distance for the hot water piping significantly is reduced, hence the pumping electrical costs, heat transfer loss cost, and the loss of heat through the heat exchangers (generally at below 80% when new). In addition, the boilers will be completely off during the warm days from spring to fall (near 8 months in California).

Based on observing the gas bill of the buildings, it is estimated that the heating system in the entire building is loosing steam thought the coils in the building. The best estimate was near $4000.00 monthly. The cost of installation of the new boilers is near $500,000.00, plus near $60,000 to install the new water heaters.

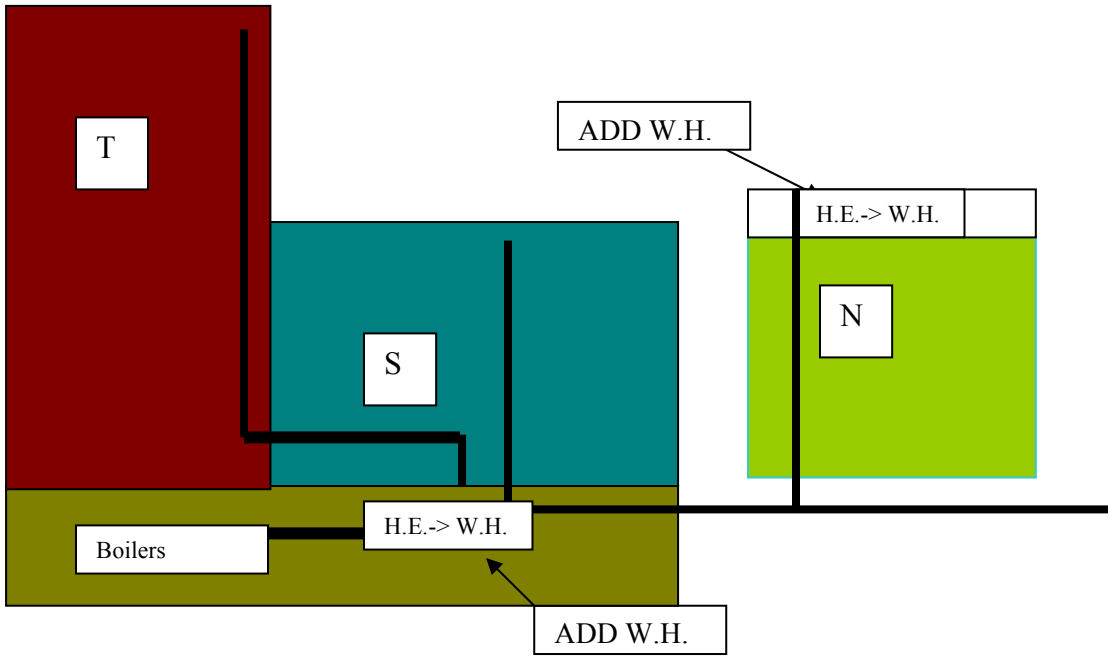
It has to be noted that the water heater installation and boiler #2 replacement are independent and can be decided as individual project.

The entire site has near 500 Lavatories (5 Gallons per hour hot water needs per lavatory), and 16 shower heads (2gpm or 60 gallons per hour - assuming 50% continuous use). Total Gallons per hour demand is 2500 + 960 = 3460 gallons per hour demand. High efficiency 199,000 btu/hr 120 gallon water heaters have 256 gallons of recovery with 90 degree rise. Assuming that the storage tanks (existing heat exchangers) are not utilized, the 3460/256 = 13 units are required scattered in three locations. The storage tanks will reduce this quantity to 8 to 10 units in the building.

The energy losses in the existing building are as follows: 1) The existing boilers are near 50% efficient, 2) the pipe loss ranges from 5 to 15% loss, 3) the loss through the heat exchangers are near 70% based on age and type of heat exchangers. A 1000 btu's spent at the steam boiler will finally have only 315 btu's or near 68% loss of energy.

315 btu's = 1000 btu's original use *0.50(Steam Boiler)* 0.90 (10% loss pipe insulation) * 0.70 (heat exchanger)

At least one to two LEED credits can be attributed to this effort.


T
S
N
ADD W.H.
H.E.-> W.H.
H.E.-> W.H.
Boilers
ADD W.H.

7. Wrap additional sun proof insulation over exposed roof piping

	Grade	Effectiveness Factor, Ef			
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W_s =	0	S =	0	S* w_S =	0
W_H =	0	H =	0	H* w_H =	0
W_F =	0	F =	0	F* w_F =	0
W_G =	0	G=	0	G* w_G =	0
Sum	0				0

Gi= 100

8. Changing the method of installation. No sanding drywall Mud.

Traditional wall mud versus traditional 5 level muds with sanding at each stage.

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	M* w_M =	0
W_s =	0	S =	0	S* w_S =	0
W_H =	0	H =	0	H* w_H =	0
W_F =	0	F =	0	F* w_F =	0
W_G =	0	G=	0	G* w_G =	0
Sum	0				0

Gi= 100

9. Remove Boiler on Roof with 5 high efficiency water heaters on first floor.

	Grade	Effectiveness Factor, Ef			
W_M =	0	M =	0	M* w_M =	0
W_s =	0	S =	0	S* w_S =	0
W_H =	0	H =	0	H* w_H =	0
W_F =	0	F =	0	F* w_F =	0
W_G =	0	G=	0	G* w_G =	0
Sum	0				0

Gi= 100

Agenda

•Introduce Sustainable Return on Investment (SROI)

•Discuss application of Risk Analysis

•Example Project

•Application for Project Prioritization

Green Investment Decisions

•How "green"?

•Why…external or internal driver?

•What's most cost-effective?

•How certain?

•When to implement?

Sustainable ROI Process

•Consensus-driven process:

–Articulate vision

–Define performance metrics

•Economics: Sustainable ROI (SROI)

•Social: Jobs generated

•Environmental: GHG reduced

•Develop model that incorporates uncertainty (risk analysis)

•Identify candidate projects

Sustainable ROI Measures

•A traditional will quantify the following cash flows over the project's life:

Initial capital expenditures and replacement capital

Annual operations and maintenance expenses

Disposal costs

•Then adjust for the time value of money using the appropriate discount rate to determine a project's Financial Return on Investment (FROI)

•An initiative is Life-Cycle Cost-Effective if the life-cycle costs of a project are estimated to be equal to or less than the base case (i.e. current practice)

Life-Cycle Cost Analysis

•Will your investment in sustainability pay off?

Financial Return on Investment (FROI): Measures cash benefits to an organization

oE.g. lower utility bills or O & M costs

Sustainable Return on Investment (SROI): Measures cash andnon-cash benefits to society as a whole

oStarts with same benefits as above but adds: lower CO2emissions, improved health & productivity, reduced waste to landfills, etc.

•HDR's SROI process assists clients who seek to maximize their triple bottom line

Economic

Environmental

Social

New LCA Methodology

Cost Benefit Analysis Framework

Costs

Benefits

Scale of Application

Johns Hopkins University

Text Box: Sample Results: FROI vs. SROI

Text Box: Sample Results: Source of Benefits
Text Box: Health & Productivity
Improved efficiency
Less sick days
Greater retention
Value of life
Value of QALY
etc

Text Box: Sample Results:
ROI and Uncertainty

Text Box: Sample Results:
SROI and Source of Uncertainty

Text Box: Sample Results: Social and Environmental Performance

Fully incorporates non-cash benefits and externalities into the decision making process

Incorporates multiple objectives

Interactive and transparent process

Risk analysis features provides level of confidence in making the right decision

Outputs are ideally suited to communicate environmental stewardship to decision makers

Key Benefits of SROI

Application for Project Prioritization

•Features:

–Flexibility

–Transparency

–Uncertainty

•Results include:

–Project Ranking with Level of Confidence

Triple Bottom Line and
Project Selection

Text Box: Triple Bottom Line and Project Ranking

SROI and Planning

•New model features integrate optimal investment over time

•Track performance against targets

•Scaling up metrics: $/per capita; $/sf

•Identify short / long-run financing

•Perform risk analysis over time

Text Box: Thank you

Our Funds: Overview

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• Management of waste and emissions	• Product quality and services	• Ethical business practices
• Environmentally beneficial products and services	• Fair labor practices, including respect for human rights	• Political accountability

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Solar Expected to Maintain its Status as the World's Fastest-Growing Energy Technology

5:00AM 03/03/09 (www.socialfunds.com)

By Robert Kropp. Decreases in cost of installation and favorable regulatory environment should protect the continued growth of solar in the US from effects of the economic crisis.

Sustainable Corporations Outperform During Economic Crisis

5:00AM 02/16/09 (www.socialfunds.com)

By Robert Kropp. Study finds that companies with commitment to sustainability have outperformed others by an average of $650 million in market capitalization.

Global Water Resources Threatened by Climate Change and Population Growth

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Investors Want More Disclosure of Climate Risk Data from Corporations

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Riskmetrics to Acquire Innovest

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New Guidelines to Help Investors Measure Success of Microfinance Institutions

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By Robert Kropp. Grameen Foundation employs data from its Progress out of Poverty Index to develop checklist of questions for investors to ask about the social benefits of microfinance.

Sustainable Investing News and Views From the Blogosphere

We scan key blogs and post the best entries related to sustainable investing.

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SRI Fund is Category King for January 2009

5:00AM 02/23/09 (www.socialfunds.com)

By Robert Kropp. Eventide's Gilead Fund is designated top multi-cap growth fund by Wall Street Journal

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Consumer Demand for Green Products is Still Rising, Survey Finds

5:00AM 02/18/09 (www.socialfunds.com)

By Robert Kropp. Survey by Boston Consulting Group of 9,000 consumers worldwide indicates that buying green products remains a priority despite economic downturn.

NRG Energy Enters Solar Field with Investment in Solar Power Plants

5:00AM 02/25/09 (www.socialfunds.com)

By Robert Kropp. Investment by NRG will help eSolar build three solar power plants using concentrating solar power technology.

Role of Corporate Boards in Sustainability Issues Is Growing

5:00AM 03/04/09 (www.socialfunds.com)

By Robert Kropp. Survey of board directors finds that as shareowner resolutions increase, more boards of directors are addressing the risks and opportunities of sustainability issues.

PRI Encourages Investors to Take More Active Ownership Role

5:00AM 03/06/09 (www.socialfunds.com)

By Robert Kropp. Principles for Responsible Investment publishes eight-point plan to help institutional investors avoid the pitfalls that contributed to current economic crisis.

Goal of New Index Series Is to Advance Gender Equality

6:00AM 03/11/09 (www.socialfunds.com)

By Robert Kropp. Pax World and KLD launch an index series sponsored by the International Finance Corporation to increase gender empowerment.

GSA: Strategically Sustainable

SUSTAINABLE SOLUTIONS

Opportunities for change available now:

Business Solutions for Sustainable Acquisition
Facilities and Operations
Leasing Best Practices
Green Construction
Virtual Workplace
Recycling and Property Disposal
GSA Tools for Buying Green
Alternative Fuel Vehicles
Sustainable Travel Programs
Green IT

A PROVING GROUND FOR INNOVATION

Learn how GSA is developing and evaluating green technologies and practices:

Electronics Stewardship
Carbon Footprint Calculator
Innovative Building Technologies
Greening the Supply Chain
Electric Vehicle Pilot Program
Investing in Clean Energy Economy
GSA's Green Purchasing Plan
Greening Federal Buildings

Leadership by example: GSA initiatives
are catalysts for change:

News

- Web Tool for Planning Green Projects - July 11, 2012
- GSA to Increase Energy Efficiency and Reduce Costs in Federal Buildings - May 17, 2012
- Energy Star Helps Federal Buildings Meet Top Performance Standards - April 26, 2012

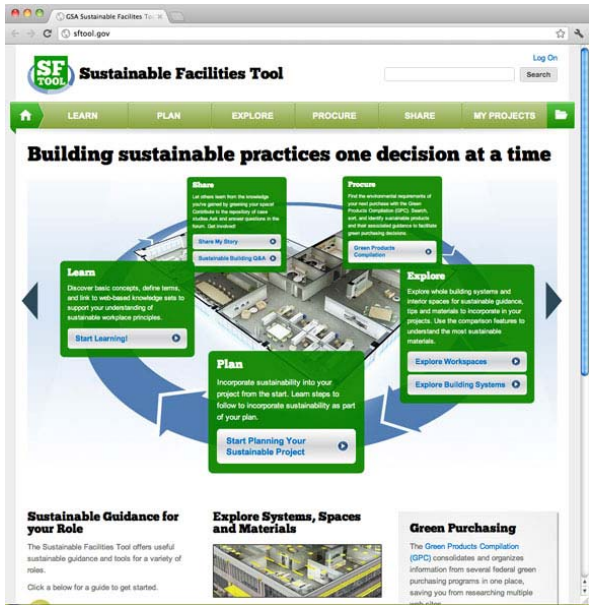
Videos

- Creating Great Workplaces for Great People
- GSA Film Profiles Renovation of

Web Tool for Planning Green Projects

Posted by Kevin Kampschroer, Director of the Office of High-Performing Green Buildings on July 11th, 2012

Imagine your agency or private business is considering a small renovation project that is supposed to be green but you are not a "sustainability expert". What would you need to know before starting the project? How would you plan something like this using sustainable building models? What about comparing green products to fit your building project? When do you need to hire an expert?



Sustainable Facilities Tool helps plan green projects

GSA's popular online Sustainable Facilities Tool – SFTool.gov – does all of these things, a one stop web tool to meet all sustainability planning, designing, and procurement needs. It's purpose is to simplify, for both government and private-sector property managers, sustainable building practices and compare options for renovation projects.

Sustainability is best thought of as a process, rather than a thing. It means to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations. New ways of designing, constructing and operating buildings and facilities must be identified to achieve such conditions.

The website offers easy to use learning tools on sustainability and green building planning, customizing sustainable work environments to suit your needs, and an integrated learning section. It also has interactive building models, including virtual office sustainable workplaces and whole building systems.

GSA has now released an upgraded version of SFTool.gov. The new version expands upon some of the features of the original to include 50 percent more web content and the green products compilation tool, which allows customers to purchase green building materials directly from the website. It also features an updated interface and new interactive user guides. Additionally, its advanced search engine will help customers find their specific building requirements.

There is also a mobile app called SF Mobile, which provides mobile access to the website on Apple, Android, and Blackberry platforms. The tool's mobile app has been downloaded more than 1400 times.

Since its initial launch in February 2011, the popular tool has informed project decision making for more than 30 federal agencies as well as states and foreign countries.

To learn more about the GSA Sustainable Facilities Tool and the new addition of the Green Products Compilation go to www.SFTool.gov.

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5:00AM 03/03/09 (www.socialfunds.com)

By Robert Kropp. Decreases in cost of installation and favorable regulatory environment should protect the continued growth of solar in the US from effects of the economic crisis.

Sustainable Corporations Outperform During Economic Crisis

5:00AM 02/16/09 (www.socialfunds.com)

By Robert Kropp. Study finds that companies with commitment to sustainability have outperformed others by an average of $650 million in market capitalization.

Global Water Resources Threatened by Climate Change and Population Growth

5:00AM 03/05/09 (www.socialfunds.com)

By Robert Kropp. Report finds that business is failing to address impact of water scarcity on its operations, and provides investors with questions pertaining to water risks to ask of

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Investors Want More Disclosure of Climate Risk Data from Corporations

6:00AM 03/10/09 (www.socialfunds.com)

By Robert Kropp. CDP survey of signatory investors finds that integration of climate risk considerations into investment decisions is growing.

Riskmetrics to Acquire Innovest

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By Robert Kropp. RiskMetrics cites expansion of research on environmental, social, and strategic governance issues as major reason for purchase.

New Guidelines to Help Investors Measure Success of Microfinance Institutions

5:00AM 02/24/09 (www.socialfunds.com)

By Robert Kropp. Grameen Foundation employs data from its Progress out of Poverty Index to develop checklist of questions for investors to ask about the social benefits of microfinance.

Sustainable Investing News and Views From the Blogosphere

We scan key blogs and post the best entries related to sustainable investing.

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SRI Fund is Category King for January 2009

5:00AM 02/23/09 (www.socialfunds.com)

By Robert Kropp. Eventide's Gilead Fund is designated top multi-cap growth fund by Wall Street Journal

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Consumer Demand for Green Products is Still Rising, Survey Finds

5:00AM 02/18/09 (www.socialfunds.com)

By Robert Kropp. Survey by Boston Consulting Group of 9,000 consumers worldwide indicates that buying green products remains a priority despite economic downturn.

NRG Energy Enters Solar Field with Investment in Solar Power Plants

5:00AM 02/25/09 (www.socialfunds.com)

By Robert Kropp. Investment by NRG will help eSolar build three solar power plants using concentrating solar power technology.

Role of Corporate Boards in Sustainability Issues Is Growing

5:00AM 03/04/09 (www.socialfunds.com)

By Robert Kropp. Survey of board directors finds that as shareowner resolutions increase, more boards of directors are addressing the risks and opportunities of sustainability issues.

PRI Encourages Investors to Take More Active Ownership Role

5:00AM 03/06/09 (www.socialfunds.com)

By Robert Kropp. Principles for Responsible Investment publishes eight-point plan to help institutional investors avoid the pitfalls that contributed to current economic crisis.

Goal of New Index Series Is to Advance Gender Equality

6:00AM 03/11/09 (www.socialfunds.com)

By Robert Kropp. Pax World and KLD launch an index series sponsored by the International Finance Corporation to increase gender empowerment.

GSA: Strategically Sustainable

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- Web Tool for Planning Green Projects - July 11, 2012
- GSA to Increase Energy Efficiency and Reduce Costs in Federal Buildings - May 17, 2012
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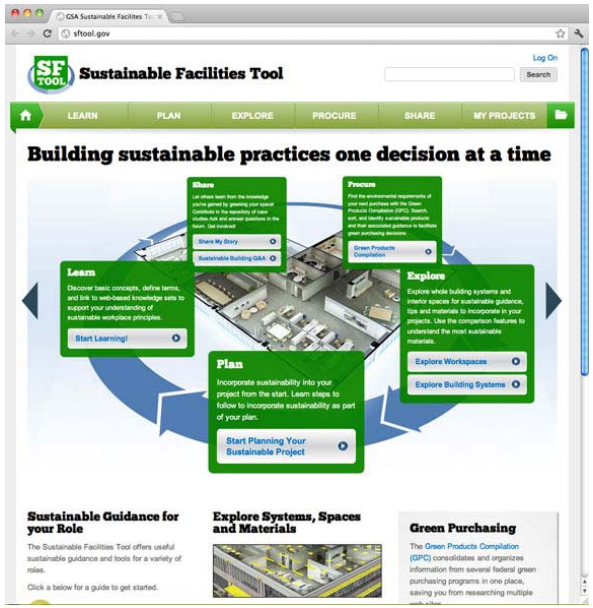
- Creating Great Workplaces for Great People
- GSA Film Profiles Renovation of

Web Tool for Planning Green Projects

Posted by Kevin Kampschroer, Director of the Office of High-Performing Green Buildings on July 11th, 2012

Imagine your agency or private business is considering a small renovation project that is supposed to be green but you are not a "sustainability expert". What would you need to know before starting the project? How would you plan something like this using sustainable building models? What about comparing green products to fit your building project? When do you need to hire an expert?



Sustainable Facilities Tool helps plan green projects

GSA's popular online Sustainable Facilities Tool – SFTool.gov – does all of these things, a one stop web tool to meet all sustainability planning, designing, and procurement needs. It's purpose is to simplify, for both government and private-sector property managers, sustainable building practices and compare options for renovation projects.

Sustainability is best thought of as a process, rather than a thing. It means to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations. New ways of designing, constructing and operating buildings and facilities must be identified to achieve such conditions.

The website offers easy to use learning tools on sustainability and green building planning, customizing sustainable work environments to suit your needs, and an integrated learning section. It also has interactive building models, including virtual office sustainable workplaces and whole building systems.

GSA has now released an upgraded version of SFTool.gov. The new version expands upon some of the features of the original to include 50 percent more web content and the green products compilation tool, which allows customers to purchase green building materials directly from the website. It also features an updated interface and new interactive user guides. Additionally, its advanced search engine will help customers find their specific building requirements.

There is also a mobile app called SF Mobile, which provides mobile access to the website on Apple, Android, and Blackberry platforms. The tool's mobile app has been downloaded more than 1400 times.

Since its initial launch in February 2011, the popular tool has informed project decision making for more than 30 federal agencies as well as states and foreign countries.

To learn more about the GSA Sustainable Facilities Tool and the new addition of the Green Products Compilation go to www.SFTool.gov.

Should You Invest In A Green Home?

March 09 2010| Filed Under » Alternative Investments, Energy, Personal Finance, Real Estate

Going green is getting a lot of attention. International climate change talks, hybrid cars and concern about the environment have caught the attention of home builders and homebuyers alike. For buyers, its not a lack of desire but a lack of availability and a lack of return on investment that make going green such a big challenge. Let's examine a few of these issues, including the definition of green, and the cost and time to breakeven. **Going Green**

Green building is a great idea, but in terms of residential construction, it's still in its infancy. Sure, high-efficiency windows and low-flow water fixtures are becoming standard features, but large-scale green building is not yet commonplace nationwide. In fact, many consumers are still unclear on the definition of "green." So what does it mean to be green? (For more, see *What Are Green Investments?*)

Energy neutral housing is the ultimate objective. Since, according to the U.S. Department of Energy, buildings use 40% of the energy produced in the United States, moving that number to zero would have a huge impact on the nation's energy consumption. Such homes are often referred to as "energy neutral" because they produce as much energy as they consume. Builders which produce net zero homes can charge up to a 10-15% premium over similar properties constructed with traditional methodologies. With tax incentives and rebates, the majority of these energy neutral properties expect to breakeven for their owners about in 12 years.

Aside from the occasional project, it's hard to find an energy neutral home. A few states have witnessed the construction of a small number of homes, but even powerhouse conglomerate General Electric doesn't envision an energy neutral home before 2015. (Learn more in *The Green Marketing Machine*.)

Energy Efficiency Standards: LEED Certified

How can you tell if your house is green? A common standard for energy efficient homes is the LEEDcertification, which refers to the Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council. They use 30% less water and 15%-20% less energy than similar, non-certified homes.

Exact figures are difficult to pin down, but various sources claim that LEED certified homes save homeowners about $70 per month through lower utility bills. Cost estimates suggest that LEED certified homes can usually be built for 2%-5% more than the average home. On a $300,000 home, that could be a $15,000 cost differential to meet the lowest of the four LEED certification levels. If you have a mortgage and pay interest on it, that number will be even higher. It takes a lot of months at $70 per month in savings to break even, and that's if you can find a builder willing and able to build the home within the projected budget. According to the Green Building Council, there were fewer than 150 LEED Platinum (the highest rating) homes in the entire country as of 2009.

The American National Standards Institute also offers a standard for green construction. They tout the ICC-700-2008 National Green Building Standard as "the first green building rating system to be approved by ANSI, making it the benchmark for green homes." Like LEED, the rating system includes four levels (bronze, silver, gold and emerald). They address issues such as lot design, energy efficiency and air quality. Even the top-rated "emerald" designation only signifies "energy savings of 60% or higher." Again, finding a home that meets these standards is easier said than done.

The practical realities of today's marketplace do make it possible for many would-be homeowners to find a home that is at least partially green. Geothermal heat, solar panels and even rainwater capture systems are readily available in some parts of the country. In areas where these features are common, the cost differential between traditional and more efficient homes is often minimal. (For more, read *For Companies, Green Is The New Black*.)

Retrofit Existing Home

If you can't find a new home that meets the green standard you are seeking, retrofitting an existing home is another option. While it is cost prohibitive to take a traditional home and turn it into an energy neutral property, you can take reasonable steps to reduce energy consumption.

The installation of better insulation, efficient windows and water fixtures, native landscaping instead of turf and a programmable thermostat can help you improve reduce energy use and save money. Most of these steps pay for themselves in just a few years. GreenandSave.com estimates that new energy efficient windows cost about $700 more than other windows and pay for themselves in about 2.3 years through energy savings. Insulating your basement walls is estimate to cost $750 and to pay for itself in two and a half years. Sealing up air leaks can cost around $554 and pays for itself in just 3.1 years. All of these steps are good for your wallet and good for the environment. (To learn more, see *Top 10 Green Industries*.)

Should You Go Green?

Going green is a great idea - it just may not always be a great investment if you are looking simply in terms of dollars and cents. Building an energy efficient home in an area when none exist is going to be expensive. It is also likely to be frustrating, as you will not only struggle to find a builder that can do the job, but your home is likely to serve as a practice project for a crew that is not familiar with green building techniques.

Building a green home in an area of existing green homes is likely to come with a cost that is at least slightly (and possibly significantly) above the going rate for similar homes. If you don't plan to stay long enough to recoup your costs, you are unlikely to save any money.

Retrofitting your existing home is likely to be a losing proposition if your goal is energy neutrality. On the other hand, you can enjoy a relatively quick return on your investment if you invest in easier to accomplish upgrades.

In every case, if your area offers the technology, and reasonable prices or tax breaks that make it a better deal, going green is the way to go. Of course like any investment, you need to research the topic thoroughly before putting your money at risk. (For more, check out our *Investopedia Special Feature: Green Investing*.)

by
Lisa Smith

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Matt Damon fracking film backed by big OPEC member

By Steve Hargreaves October 1, 2012: 12:54 PM ET

Matt Damon's new fracking film is generating controversy over its funding.

Matt Damon's new film on fracking, "Promised Land", is generating some buzz -- though probably not the kind studio execs were hoping for.

Last week, the conservative think tank **Heritage Foundation pointed out** that in the trailer for film, one of the financial backers listed is Image Nation Abu Dhabi.

Image Nation Abu Dhabi is, in turn, owned by Abu Dhabi Media - a state media company for the United Arab Emirates. The UAE, an OPEC member, is the world's third-largest oil exporter.

For a film that highlights the dangers of fracking -- the controversial process that has unleashed an energy boom in the United States -- this may be problematic, as evidenced by Twitter posts Monday:

Scott Manley@ManleyWMC

Matt Damon makes anti-fracking propaganda film funded by United Arab Emirates. Trying to keep USA dependent on OPEC?**blog.heritage.org/2012/09/28/mat…**

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Power Line@powerlineUS

Green Weenie of the Week: Matt Damon.**powerlineblog.com/archives/2012/…** Has there ever been a more deserving Green Weenie winner? **#tcot**

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Critics contend the UAE is trying to drum up opposition to more U.S. oil production, which could compete with its crude exports.
It's also possible the UAE -- which has financed at least a half-dozen Hollywood films -- overlooked the conflict of interest and simply thought the film was a good investment due to its all-star cast (Oscar winner Frances McDormand and John Krasinski of "The Office fame co-star) and director (Gus Van Sant).
A spokeswoman for Image Nation Abu Dhabi said that while the company gets "supporting funds" from the Abu Dhabi government, it is a "commercially-driven and independently-operated" entity.
A spokeswoman for Participant Media, which arranged financing for the film, said the funding was part of a larger deal with Image Nation Abu Dhabi to invest in 15 to 18 films over a five year time period, "regardless of genre or subject matter."
Either way, the revelation could be a setback for a film on an important U.S. energy topic, and will only give ammunition to critics who say the movie was biased from the get-go.
There is a lot of talk around the TreeHugger virtual water cooler these days about the merits of green and ethical investing. The timing might be a bit off, what with stocks falling off a cliff, housing in turmoil and oil over a hundred bucks a barrel, but such crises often beget opportunities. It is tough, too; even Richard Branson can make mistakes and now regrets his investments in ethanol.

he 3 Best Renewable Energy Investments: Make Money Without Losing Your Shirt

Sep 16th, 2011 | Matt Insley | Category: Alternative Energy

It's rare to find two news blurbs that are so eloquently juxtaposed, not to mention investable.

In today's *Wall Street Journal* we found one article titled "Loan Was Solyndra's Undoing."
Solyndra, if you recall, is the now bankrupt solar company that acquired a $535 million "green energy" loan from the U.S. government. Notably, Obama made news with this particular loan after visiting the Solyndra plant in 2010.
It's now coming into focus that the taxpayer-backed loan (probably never to be paid back) was actually the company's undoing. One investor told the Journal "the worst thing that happened to Solyndra was the loan."

In another story, as CNN Money reports: the controversial Energy Department loan program that backed Solyndra could nearly double in size by the end of the month.

The article shows that the government has until September 30th to approve several other loan guarantees — which could add another $9B in loans to the already $10B program.

Don't you just love the system!

When you look at the Solyndra story it couldn't be clearer. The government money propped up an inefficient business model. Once a sought after design, the solar cell technology that Solyndra produced eventually backfired — prices for conventional solar cells dropped, ruining Solyndra's competitive edge.

After receiving the government loan Solyndra chose to prolong their outdated and inefficient tech — something we can assume no self-funded company would do. As it happens, investors in the private company will probably lose their shirts (including you and me as U.S. taxpayers.)

Unfortunately today we're seeing that the U.S. government isn't short on pen ink to sign these loans. Which means there may be plenty more of these pitfalls around the corner.

That's why it's imperative that you learn about a safer more profitable way to invest in green energy.

3 WAYS TO PROFIT FROM GREEN TECH…WITHOUT LOSING YOUR SHIRT

If you're a new reader this idea may come as a surprise, but the best ways to invest in the green energy boom is a solid portfolio of well-established "big energy" companies.

Today I'd like to share with you three of my favorites.

The following companies will give you a safer look at green energy. Instead of buying into risky start-up companies — many of which will fail and few of which will profit — it's smarter to buy already profitable companies that can add to their bottom line with green tech.

No. #1 The Leading Geothermal Energy Producer in the World
Want to venture a guess on the world's leading geothermal energy producer?

If you said Ormat, or any other geothermal pure play, you're wrong.

Instead the leading geothermal energy producer in the U.S. is a name you know well, **Chevron Corp. (CVX: NYSE).**
We've covered Chevron in these pages before — and to be clear it's a world leader in oil exploration and production.

Unknown to many, Chevron is also a highly diversified and profitable renewable energy company. Through its *Chevron Energy Solutions* division the company has become a leader in energy conservation, geothermal and solar technologies.
In an article explaining what it calls "emerging energy" Chevron says "In early 2011 it began operations at what may be the largest concentrating solar photovoltaic power plant in the United States." The plant, as the article says "uses lenses to focus sunlight onto three-layer solar cells. The technology is anticipated to be twice as efficient as traditional solar panels and generate about 1 megawatt of power to be sold to a local utility."

This emerging energy initiative will keep Chevron moving in the renewable direction — adding more profit opportunities in the years to come.

No. #2 A World Leader in Wind and Solar
The second company that I'd like to highlight is also a household name, **General Electric (GE: NYSE.)**
GE is a world-class leader in technology, something that our resident energy expert Byron King has talked about in the past.

As Byron said "I honestly LOVE the GE business divisions that deal with "real" things, like jet engines and locomotives and power generators and windmills and subsea equipment. I get misty-eyed, thinking of all the wonderful GE people who work in those metal-bending divisions, toiling at their workbenches and making the world a better place."

GE is the 3rd largest wind turbine manufacturer in the world. It's also a world-wide leader in solar — of note is it's work on Brazil largest solar plant.

General Electric, Bloomberg reports, is "the world's biggest maker of electricity-generating equipment, will add 1 megawatt of power capacity to Brazil's largest solar plant, and may eventually expand the facility to 50 megawatts."

Green start-ups have their work cut out for them trying to compete with GE's prowess in wind and solar. Adding yet another reason that you may want to steer clear of start-ups in the green tech industry.

But before we move on, there is a caveat with GE. As Byron King said "I've often asked whether the GE industrial side can earn profits for the company faster than GE Capital can lose money."

So GE may not be a "buy" as much as reason to "not buy" startups.

No. #3 The Next Generation of Biofuel
What happens when you add the deep pockets of an energy giant to the insight of the guy who pioneered the human genome project?

You get **Exxon Mobil's (XOM: NYSE)** Algae Biofuels Research and Development Program.
On a mission to find a sustainable biofuel, Exxon teamed up with Synthetic Genomics and Craig Venter, a leading scientist and entrepreneur who has been a driving force in genomics for more than three decades, known for the sequencing and analysis of the human genome. (Incidentally, our executive publisher Addison Wiggin is on a plane right now to go interview Venter… should be interesting!)

Here's the point. Exxon is a proven winner in the world of energy and when they devote this much time and energy to a project it's hard to see why anyone would bet against it.

Since the project's inception in 2009 Exxon has evolved biofuel in leaps and bounds. Here's one benefit Exxon notes:

> Algae have the potential to yield greater volumes of biofuel per acre of production than other biofuel sources. Algae could yield more than 2000 gallons of fuel per acre per year of production. Approximate yields for other fuel sources are far lower:
>
> - Palm — 650 gallons per acre per year

- Sugar cane — 450 gallons per acre per year

- Corn — 250 gallons per acre per year

- Soy — 50 gallons per acre per year

Instead of betting on ethanol subsidies (a losing bet like Solyndra) you can put your money down on an already profitable energy company that's pioneering technology in biofuels.

THE BEST WAY TO MAKE MONEY IN GREEN ENERGY…

Being a leader in the renewable industry isn't easy. Start-ups face a, sometimes insurmountable, uphill battle. So instead of betting on a handful of startups I'd urge you to look at an established energy companies like, say, Chevron or Exxon.

Chevron's management, for example, has a proven track record of energy success — that's not an easy task. And it's especially not something that a government-backed green loan can provide.

Unlike smaller, pure play green companies you don't need to worry about this energy leader turning a profit (and paying a dividend to boot.)

That's the trend I see in the green-tech field. For now keep your investment dollars safe and look to profit opportunities in well-established energy companies.

Keep your boots muddy,

Matt Insley

MATT INSLEY

The Managing Editor of the *Daily Resource Hunter*, Matt is the Agora Financial in-house specialist on commodities and natural resources. He holds a degree from the University of Maryland with a double major in Business and Environmental Economics. Although always familiar with the financial markets, his main area of expertise stems from his background in the Agricultural

and Natural Resources (AGNR) department. Over the past years he's stayed well ahead of the curve with forward thinking ideas in both resource stocks and hard commodities. Insley's commentary has been featured by *MarketWatch*.

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Investment in the green building sector is booming

April 18, 2008 6:35 AM
Jeremy Jacquot

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The green building sector has been awash with VC cash in recent months: Despite there only being a few dozen startups in the nascent field, investors have started paying close attention — helping several raise new rounds of funding.

Newark, California-based CalStar Cement has received $3.4 million from several investors, including Foundation Capital, while Serious Materials landed a hefty $50 million second funding round, led by New Enterprise Associates, Rustic Canyon Partners and Foundation

Capital. The Sunnyvale-based startup had earlier capped a $5 million first round. Los Gatos-based Calera, which is developing a cement capable of sequestering carbon dioxide, is backed by Khosla Ventures.

New Jersey-based Hycrete, which produces an admixture (or liquid solution) that is used to waterproof concrete, completed its second round in 2006. Just one more, CEO David Rosenberg says, could take it to profitability; in late February, he said he was seeking $10 – 20 million. Its investors include RockPort Capital Partners and NGEN Partners. Hycrete's admixture was one of the first to receive a cradle-to-cradle certification through McDonough Braungart Design Chemistry, a green product and design firm. The designation "cradle-to-cradle," coined by architect William McDonough and Michael Braungart, refers to a product that can be completely recycled or re-used. It was also selected as a Technology Pioneer at this year's World Economic Forum.

A mixture of sand, aggregate, cement and water, the admixture acts as a replacement for the external membranes that are typically used to keep water from seeping into concrete. When it is mixed into concrete, it links up to metallic ions and behaves like a hydrophobic solution (like oil) — repelling water. Because it doesn't require volatile organic compounds (VOCs) or other harmful chemicals, the corrosion-resistant concrete can safely be recycled and reused in other projects. Conventional forms of concrete, which use permanently bonded waterproofing membranes, are sent to landfills.

Hycrete's technology has already been used in more than 75 projects worldwide — including several Marriott and Hilton hotels and condos and apartments in Seattle. Other applications include mixing it into roofing material to make green roofs — roofs covered by lawns — or into drywall to stop moisture seepage.

Serious Materials The admixture reduces energy waste, cuts costs and lets builders receive Leadership in Energy and Environmental Design (LEED) points. Developed by the U.S. Green Building Council, the LEED accreditation indicates a building has successfully adopted a suite of rigorous green building standards. The rating is seen as a boon by companies seeking to bolster their environmental credentials and is increasingly being implemented in new construction projects. Hycrete's product helps builders reach that goal faster.

Green building investment trends: Extreme green and net-zero are in

August 29, 2012

When tracking trends in sustainable design, it's interesting to see where venture capitalists are investing their money in the environmental sector and how technologies that they are funding might impact sustainability standards. Recent investments in green building are focusing

on achieving "extreme green" or "net-zero" status.

“Early VC investors are looking for exits for the first wave of successful green buildings start-ups, and the seeds of the next crop are being sown in on-site generation and sustainable materials,” says Lux Research Analyst Ryan Castilloux. Findings in Lux Research’s new report, “Building a Green 21st Century: Tracking Venture Investments in Green Buildings to Uncover New Opportunities” include:

- Driven by the European Union’s aggressive energy efficiency targets, as well as similar long-term targets in the US and elsewhere, “integrated design” will attain key importance.
- On-site generation materials and systems are hot investments, with the sector raking in a combined $983 million. A new framework of incentives for on-site power generation and combined heating and energy is pushing more investment. Companies making micro-generators and those with systems that convert waste heat to electricity bear watching.
- The concrete production industry accounts for about 4% of all global carbon emissions. Since 2005, venture capitalists have invested $114 million into seven developers working on low-carbon concrete. Lux expects these materials to become the norm in geographies where urban building booms are taking place, such as the BRIC nations of Brazil, Russia, India, and China.

Click here to read more. +

Author's Biography

Lynne Simnick is the Director of Code Development for the International Association of Plumbing and Mechanical Officials (IAPMO) and is responsible for the supervision and oversight of the creation and maintenance of all IAPMO codes and code supporting documents. Ms. Simnick has more than twenty-eight years experience in the plumbing industry including code development, education and training, plan review and evaluation services. Prior to joining IAPMO, Simnick worked as technical staff in engineering services, educator, inspector and plumber. She has a Bachelors of Science Degree in Education and Mechanical Engineering Technology. Simnick has authored many technical articles, participated in numerous standards committees with an expertise in code and standards development. Ms. Simnick may be contacted at IAPMO, 909-472-4110 or email lynne.simnick@IAPMO.org

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By **GreenBiz Staff**
Published October 16, 2003
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WASHINGTON, D.C. — Investments in green buildings pay for themselves 10 times over, according to a new study for 40 California government agencies.

The study, by the Capital E group, Lawrence Berkley Laboratory, and participating California state agencies, is the most definitive cost-benefit analysis of green building ever conducted.

With this study, the California Department of Finance, for the first time, has recognized the existence of financial benefits associated with improved health productivity and lowered operations and maintenance costs in green buildings. The California Board of Regents also drew on the early findings of this study and is moving forward in pushing for all state higher education new construction to be "green." This study, drawing on national data for 100 green buildings and an in depth review of several hundred existing studies, found that sustainable buildings are a very cost-effective investment.

"Green" or "sustainable" buildings use key resources like energy, water, materials, and land much more efficiently than buildings that are simply built to code, the study points out. They also create healthier work, learning, and living environments, with more natural light and cleaner air, and contribute to improved employee and student health, comfort, and productivity. Sustainable buildings are cost-effective, saving taxpayer dollars by reducing operations and maintenance costs, as well as by lowering utility bills.

The report concluded that financial benefits of green design are between $50 and $70 per square foot in a LEED building, over 10 times the additional cost associated with building green. The benefits include cost savings from reduced energy, water, and waste; lower operations and maintenance costs; and enhanced occupant productivity and health.

“Total financial benefits of green buildings are over ten times the average initial investment required to design and construct a green building,” concluded the authors. “Energy savings alone exceed the average increased cost associated with building green. Additionally, the relatively large impact of productivity and health gains reflects the fact that the direct and indirect cost of employees is far larger than the cost of construction or energy. Consequently, even small changes in productivity and health translate into large financial benefits.”

USGBC President & CEO, Christine Ervin who served as a member of an advisory committee that guided the study, says, “The study’s conclusive findings demonstrate that green building is cost-effective and makes good business sense.”

Greg Kats, a Principal at Capital E, and the lead author of the report stated that “The report should permanently lay to rest the myth that green buildings are not cost effective and not ready for prime time.”

Download the report online.

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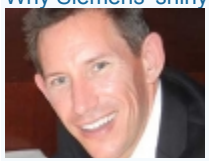

Steven Avadek: Banking on green buildings at Citigroup

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This dynamic panel will bring a range of perspectives to the current state of green building finance and development in New York City. Leading practitioners will present current work in development and asset management, financial incentives, regulatory reform, research and corporate philanthropy targeting the construction and upgrading of greener buildings. The panel will focus on reviewing both financial and policy obstacles and opportunities to achieving greener buildings. Speakers: Charlotte Matthews is Vice President of Sustainability at Related Companies, New York City's preeminent developer of mixed use residential and landmark retail properties. Charlotte recently Chaired the Construction Practices committee on the Urban Green Council's Green Code Taskforce which has resulted in a dramatic overhaul of New York City energy and building codes. Sam Marks is Vice President of Deutsche Bank Americas Foundation. In concert with corporate focus on climate change research and investment, Sam is leading an innovative analysis of 300 building retrofit projects to examine the relationship between projected and actual energy savings and better recognize energy efficiency in multifamily underwriting guidelines. Dana Schneider is Vice President of Sustainability Services at Jones Lang LaSalle. Dana recently directed JLL's management of a $500M building retrofit program for the Empire State Building in collaboration with the Clinton Climate Initiative, Rocky Mountain Institute and Johnson Controls. Michael Karlosky is Director, Sustainable Public Infrastructure, Wells Fargo Securities. Michael has served as lead/senior banker for the State of New Jersey, City of New York, City of Philadelphia, New Jersey Economic Development Authority and New York State Housing Finance Agency.

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Why The Competitive Edge Green Finance Workshops?

It's no secret that the current real estate climate leaves no room for error. While investments in green building are on the rise, the need for rock-solid accountability is increasing. Most important decisions today about green building and energy efficiency investments require a thorough business case. Everyone talks about the 'business case' for green buildings, but surprisingly few know what this means or can tell the difference between a strong case and a weak case.

Who Should Attend

- Those in green building, development, and investing who are responsible for projects, programs or proposals
- Managers who need to bring consistency, discipline and accountability to decision making around green building planning and investments in their organization
- Consultants and contractors who work with green building professionals, developers and investors
- Facilities and/or business people responsible for capital spending decisions
- Sales or business development professionals who need to show customers that the decision to invest in green building is a good decision

What You Will Learn

The Competitive Edge Green Finance Workshops feature hands-on analysis training with green building investment examples. The workshops provide comprehensive, one-day practical guidance in:

- The logic and components of the green building business case that "makes the case"
- LEED BD&C and EBOM credit impacts on the property operating cashflow and overall project profitability
- Implementing important metrics in your financial and environmental performance results (including NPV, IRR, Payback Period and ROI)
- Incorporating quantitative tools such as Life Cycle Cost Analysis in decision making
- Methods for bringing non-financial benefits and costs into the green building business case
- Taking the "intangible" out of "intangible benefits"
- The latest green financial programs and incentives that can benefit commercial building energy efficiency and green certification

In-Depth, High-Value Resources

You will take away a suite of highly professional, in-depth resources that will support you in your work long after completing the class:

- One copy of Green Building Business Case Essentials – our new guide to creating the green building business case that "makes the case"
- Exercise Workbook
- Financial Modeling Techniques

About the Instructor

The Competitive Edge Green Finance Workshops were developed and are led by**Lisa Michelle Galley**, CEO of Galley Eco Capital. Ms. Galley has 25 years commercial real estate finance and investment experience managing commercial real estate lending and developing finance and investment programs internationally. Ms. Galley's career includes the finance of some of the earliest LEED certified investment properties in the US as well as the financial analysis, credit and investment decision making on billions of dollars of commercial real estate loans and investments internationally. Ms. Galley is a recognized authority on green building finance, green building investment analysis, and financial program development. She speaks and publishes often on green building finance issues, and teaches graduate Managerial Finance at Presidio Graduate School's Green MBA and MPA programs. She is Treasurer of the USGBC-NCC and a member of the national USGBC's Finance & Audit Committee.

Federal Green Buildings

STATEMENT OF
KEVIN KAMPSCHROER
DIRECTOR
OFFICE OF FEDERAL HIGH-PERFORMANCE
GREEN BUILDINGS
OFFICE OF GOVERNMENTWIDE POLICY
U.S. GENERAL SERVICES ADMINISTRATION
BEFORE THE
SUBCOMMITTEE ON GOVERNMENT MANAGEMENT, ORGANIZATION, AND PROCUREMENT
COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM
U.S. HOUSE OF REPRESENTATIVES
JULY 21, 2010

Good morning, Chairwoman Watson, Ranking Member Bilbray and members of this Subcommittee. My name is Kevin Kampschroer and I am the Director of the Office of Federal High-Performance Green Buildings (OFHPGB) at the United States General Services Administration (GSA). Thank you for inviting me today to discuss the progress and challenges of green building practices in the Federal Government.

Congress created the OFHPGB to enable and enhance Federal leadership in the field of large scale sustainable real property portfolio management and operations. Chartered in December 2007 under Section 436 of the Energy Independence and Security Act (EISA), the office combines authoritative knowledge of Federal processes with multidisciplinary expertise in high-performance green buildings to provide leadership within GSA, the Federal Government, and the broader commercial property market to ensure that our buildings minimize their burden on both the environment and the taxpayer. The office is housed within GSA, which provides 362 million rentable square feet of work space and is one of the largest and most diversified public real estate organizations in the world.

Since initiating operations, OFHPGB has moved aggressively and resourcefully to fulfill its mandate. Even before the funding provided through the Recovery Act, the office began planning innovative programs to coordinate Federal high-performance buildings activities, accelerate technology commercialization, and foster adoption of sustainable practices at all the lifecycle stages of Federal assets.

A principal duty of the OFHPGB is to ensure full coordination of high-performance green building information and activities within GSA. Under the Recovery Act, GSA received $5.55 billion to be re-invested in the Federal buildings portfolio on an accelerated basis. GSA leveraged its specialized expertise in sustainability and procurement practices to support investment of these funds, consistent with the intent of the Recovery Act, to create jobs, develop high performing green buildings, and support the President's and Congress's vision for a clean energy future. GSA is committed to an integrated focus on the whole lifecycle of Federal buildings, to ensure that, by investing carefully in the best technologies and practices, we provide significant savings and value to the taxpayer over the full life of our buildings.

Greening GSA Recovery Act Projects

In the months immediately following passage of the Recovery Act, OFHPGB engaged directly with GSA's Public Buildings Service (PBS) to support Recovery Act procurements. Principal contributions by the office included establishment of Minimum Performance Criteria to guide the scoping and execution of Recovery Act projects to transform Federal buildings into high-performance green buildings.

Compared to average buildings, high-performance green buildings use less energy, water, and material resources; have better indoor environmental quality; reduce air and water pollution, and produce less waste; use environmentally preferable products; have integrated systems; use sites well and use local transportation to reduce adverse impacts on the local community; and improve conditions for the health and productivity of the buildings' occupants.
Among projects identified as appropriate for Recovery Act funding, GSA examined opportunities to improve the performance of projects already designed, with a focus on building systems, human performance, renewable energy generation and water conservation. GSA prioritized buildings with the worst performance in energy and poor physical conditions, and the best plans for improvement.

The following improvements were incorporated into all projects, where possible, based on funding and return on investment:

1. Building tune-up (re-commissioning, controls improvements, minor systems repairs and equipment replacement)
2. Lighting (day lighting control and occupancy sensors; control systems replacement and re-wiring)
3. HVAC retrofit/replacement
4. Renewable energy generation by photovoltaic, thermal solar or wind
5. Water conservation projects

In addition, GSA has worked to establish geothermal and lighting technology acceleration programs.

An example of a GSA project taking full advantage of these greening opportunities is the modernization of the Edith Green/Wendell Wyatt Federal Building in Portland, OR to attain the US Green Buildings Council's (USGBC's) Leadership in Energy and Environmental Design (LEED) Platinum rating – the highest LEED rating available. Using highly advanced design features, the finished structure will consume about 60 percent of the energy of a typical office building. It will incorporate an exceptional 18-story façade that integrates shading and reflective devices optimized for each direction of the building's location, orientation, and local climate. Compared to conventional high-rise buildings, the facility will use 65 percent less potable water.

GSA's Green Proving Ground

GSA is leveraging our Recovery Act investments to turn our large, varied and stable inventory of buildings into a proving ground for green building technologies, materials, and operating regimes. By adopting new ideas and products, then evaluating and publicizing our results, GSA is working to become one of the commercial real estate industry's "go to" sources for data on the environmental and economic payback of new systems and procedures. Our investments in innovative technologies and alternative energy solutions can help lead the transformation to new green jobs and green industries. Table 1 below identifies the number of green technologies we are including in our projects.

GSA is also pursuing projects that will upgrade the performance of specific systems within many of our buildings. These "Limited Scope" projects focus on improving energy performance and are evaluated in the context of the existing physical condition of the building. We evaluated these buildings and identified opportunities to "tune-up" the systems, improve building mechanical system controls, recommission building systems and retrofit or replace lighting or HVAC systems. To better achieve the goals of EISA, we particularly focused on those projects related to renewable energy production and water conservation.

In addition to the Limited Scope projects, PBS has obligated over $110 million for High-Performance Green Building Small Projects that represent other opportunities for implementing measures to convert our buildings to high-performance green buildings. These projects tend to be smaller in scope and size.

Incorporation of green building standards and practices

GSA has worked to support and apply the most effective green building rating systems and standards. Drawing from objective analysis performed by the Pacific Northwest National Laboratory (PNNL), GSA identified LEED as the most effective rating standard for the Federal real property inventory to attain, with a focus on the New Construction (LEED-NC) system and a minimum rating of Silver. The PNNL study, Sustainable Building Rating Systems (2006), screened more than 30 sustainable building rating systems and conducted in-depth analysis on 5 of the highest priority candidates. Based on the analysis, GSA selected the LEED rating system because it provides:

- The ability to be relevant to the scale and complexity of Federal buildings;
- Stability over time, such that evaluation of a building's performance is not subject to dramatic changes;
- Objective measures of sustainable design, verified by third parties;
- Wide availability, with broad practitioner awareness.

GSA formally conveyed this finding to the Department of Energy (DOE) in April 2008. DOE officials subsequently issued draft regulations that are currentlyundergoing review. GSA will evaluate sustainable building rating systems again in 2011 and may elect to provide additional guidance on this designation and its application.

GSA already requires that a LEED rating of Silver or better be part of the design criteria for all GSA new construction and major renovation projects; the agency currently has 48 LEED-certified owned and leased buildings with approximately 150 more working towards accreditation. Eighteen of these projects have exceeded the minimum with LEED Gold certifications, and one GSA lease, the FBI Regional Office in Chicago, has achieved a Platinum LEED rating for Existing Buildings.

As Figure 1 indicates, the number of LEED-certified projects across all Federal agencies has increased substantially in recent years. According to the USGBC, the Federal Government currently has 241 LEED certified projects with another 3,373 pursuing certification. At least 14 Federal agencies have policies to promote the use of LEED in their buildings.

EPA's ENERGY STAR® system is also used by GSA and other Federal agencies to track and improve building energy efficiency – GSA currently has over 130 buildings with an ENERGY STAR® Buildings label. EISA Section 435 requires that all new Federal leases, with a few exceptions, must be with ENERGY STAR® labeled buildings.

In addition, GSA has supported and participated in the 3-year development process for the recently-published American National Standards Institute (ANSI)/American Society for Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)/USGBC/Illuminating Engineering Society (IES) Standard for the Design of High-Performance Green Buildings (ASHRAE 189.1). The standard provides a code-enforceable "total building sustainability package" to enable Federal buildings to comply with Federal green building requirements.

Measuring Federal green building performance

A 2008 study of GSA's 12 earliest green federal buildings shows energy consumption down 26% and occupant satisfaction up 27%, compared to commercial office benchmark data in those regions. More importantly, the top third of studied buildings, which use an integrated design approach, deliver significantly better results with 45% less energy consumption, 53% lower maintenance costs, and 39% less water use. We are now working to expand this analysis to cover more of GSA's green buildings.

As you will hear from our colleagues at DOE, DOE's Federal Energy Management Program collects extensive data on Federal energy and water use. GSA tracks these data closely for our buildings.

Since FY 2003, GSA has reduced its energy intensity by 14.3 percent in our public buildings and those leases where GSA is responsible for making utility payments. GSA has reduced its total annual energy consumption over the period FY 2003 to FY 2009 by nearly 878 billion BTUs, and is well ahead of its energy intensity reduction target of 12 percent by FY 2009. (These figures include "credits" for the purchase of renewable energy from energy suppliers.)
GSA has also been actively working with the U.S. Environmental Protection Agency (EPA) to tailor Portfolio Manager – EPA's interactive energy management tool for tracking and assessing energy and water consumption across an entire portfolio of buildings in a secure online environment – for Federal uses. GSA has been working with EPA to add functionality to Portfolio Manager to include other building aspects besides energy and water consumption so that Federal agencies may use it to meet all the requirements of Executive Order (EO) 13514.

GSA also tracks environmentally preferable purchasing in compliance with Federal mandates. For example, in 2009, GSA spent over $2.3 million on recycled content products, and our national janitorial contracts now require the use of green cleaning products.

There are a number of major challenges related to measuring green building performance outcomes. A key issue is increasing the number of advanced or "smart" meters in Federal buildings tracking energy and water usage. GSA, as an active member of the Office of Science and Technology Policy's (OSTP) subcommittee on Buildings Technology Research and Development (BTRD), is supporting that committee's project to study metering issues and technology and how metering may be expanded.

Beyond the use of resources like energy, water and to some extent, materials and waste, other environmental and health impacts are frequently more difficult to track. Indoor environmental quality (IEQ) is particularly difficult to track and measure, since it involves such a wide variety of pollutants – chemical, biological, gaseous and particulate – as well as atmospheric conditions including ventilation, lighting, acoustics, daylighting and views, all of which interact and can impact occupants' health and productivity in many ways. Research to develop user-friendly IEQ metrics is, therefore, needed.

Other environmental aspects of buildings for which better metrics are needed include stormwater impacts of construction, lifecycle assessment of materials and products, and the impacts of siting on transportation and other community dynamics.

Federal Financial,Bbudgetary and Marketplace Issues

High-performance green buildings provide the best value for the taxpayer and for the public through both life cycle cost benefits and positive effects on human health and performance. According to the 2008 McGraw-Hill Construction SmartMarket Report: Key Trends in the European and U.S. Construction Marketplace, operating costs for green buildings are on average 8 to 9% lower, building values are 7.5% higher, buildings have a 3.5% greater occupancy ratio, and green buildings provide a 6.6% total return on investment.

Indeed, the life cycle costs of well designed and maintained green buildings are usually lower than the life cycle costs of conventional buildings. Even the initial capital costs are not necessarily higher, and when they are, only marginally so. GSA's study of the initial capital cost shows that the increase on average is about 3 percent, ranging from zero to ten percent, depending on the design. Similarly, a private sector study by Davis Langdon in 2007 shows that green buildingfeatures tend to have a lesser impact on costs than other building decisions, such as which kind of finishes and amenities the building might provide.

Currently, Federal capital budgeting processes do not adequately take into account the life cycle cost savings of high performance green buildings, even when upfront costs are higher. High-performance buildings can deliver additional benefits that are harder but not impossible to monetize, such as carbon emissions reductions, improved resiliency to energy market disruptions, and higher worker productivity. GSA has sought to make incremental improvements to existing lifecycle costing methodologies in order to better meet the needs of energy-related investments. Specifically, GSA has initiated preliminary discussions with the National Institute of Standards and Technology Office of Applied Economics to update the lifecycle cost methodology to take into account an EISA-mandated increase in the time period for lifecycle costing from 25 to 40 years. This change would provide a longer window for energy projects to pay back their first costs, thereby increasing the scope of viable projects.

The Federal Government's ability to invest in the projects with the greatest environmental benefits would also be advanced if the authority of agencies to make contracts for renewable energy were extended from the current 10 years to 20 years.

Another marketplace challenge is the lack of skilled labor to put green building technologies and practices into effect in new construction, renovation, operations and maintenance. Significant worker training and retraining will be needed to meet the green building goals of EISA and EO 13514.

Interagency Coordination

GSA has a long history of working cooperatively and effectively with our Federal partners on these issues. Consistent with its EISA charter, GSA has dedicated significant resources and expertise to a variety of interagency green buildings initiatives. GSA coordinates much of its interagency agenda through existing Federal interagency bodies – such as the Interagency Sustainability Working Group, which GSA has just begun to co-chair with DOE's Federal Energy Management Program, and the OSTP subcommittee on Buildings Technology Research and Development (BTRD). In addition, GSA participated in the creation of the DOE's Commercial Real Estate Energy Alliance.

OFHPGB is taking a leading role in GSA's compliance with and implementation of Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance .
• The office has participated in the testing of GHG accounting protocols and submitted reduction targets to CEQ for GSA's Scope I and Scope II emissions. The Office has already written guidelines on GHG accounting in Federal sector customer–landlord situations and developed internal accounting protocols for Scope III emissions.

• GSA has also laid a foundation for agencies to build their internal capacity to meet the mandates of the EO by developing teams to train and assist other agencies in the development of their GHG reduction targets and abatement plans.

• GSA is assisting CEQ to implement the EO by developing simplified reporting requirements, metrics, and tools.

• GSA sponsored a symposium with the Federal Facilities Council, DOE, ASHRAE and the International Facility Management Association on the challenges related to the "net zero" carbon design goal. The proceedings provide a blueprint for agencies to use in meeting the already aggressive targets related to the reduction of the use of fossil fuel-generated energy, which have been accelerated by the EO.

• GSA also was the lead coordinating agency for the development of two sets of recommendations to CEQ required by EO 13514: "Recommendations for Federal Local Transportation Logistics" (Section 11) and "Recommendations for Vendor and Contractor Emissions" (Section 13). GSA is a designated collaborator on three other sections: "Recommendations for Greenhouse Gas Accounting and Reporting" (Section 9), "Recommendations for Sustainable Locations for Federal Facilities" (Section 10), and "Guidance for Federal Fleet Management" (Section 12).

Environmental and Health Benefits of High Performance Green Building

Buildings have countless impacts on the environment, the economy, natural resources and occupant health and productivity extending far beyond the building footprint. Buildings use almost 40% of all energy, emit nearly 40% of carbon dioxide emissions, use 13% of our freshwater resources, generate over two-thirds of all non-industrial secondary materials, and form an indoor environment where Americans spend 90% of their time, subject to higher levels of pollution than in the outdoor environment.

Effective green building design, operations and maintenance offer economic, environmental and societal benefits. If a building decreases its energy consumption, the cost of operation is less, the asset value increases, and the production of greenhouse gases decreases. Building water use, wastewater generation and stormwater runoff affect the quality of our water bodies, the public water supply, and the need to build expensive new water infrastructure.
The careful selection and use of materials can reduce energy consumption during the manufacturing process and protect the health of occupants. Careful construction techniques can reduce the amount of construction waste that reaches landfills by 95% or more .

EISA states that a high-performance green building must not just perform well mechanically, but perform to improve the health and enhance the performance of the occupants. Indoor air frequently has levels of air pollution 2-5 times, and sometimes as much as 100 times, higher than outdoor air, and poor indoor air quality can increase respiratory diseases and even the risk of cancer. Lighting quality, including levels of daylighting and views, have significant impacts on employee productivity and satisfaction, as the PNNL has found. Carnegie Mellon University has documented over 100 scientifically valid studies that demonstrate the link between high-performance features and various aspects of productivity.

Some key green building approaches have multiple benefits. For example, a planted or “green” roof can lower roof temperatures, and thus cooling costs, while reducing the urban heat island effect and storm water runoff, absorbing some air pollutants and providing wildlife habitat. In cities like Washington DC, with a combined storm water and sewer system, this reduces water pollution both locally and downstream in the Chesapeake Bay.

We need to put at least as much emphasis on actual building performance, based on regular operations and maintenance, as on design, as several state and local governments are beginning to require.

Conclusion

Thank you again for this opportunity. All of us at GSA are excited by the contribution you have allowed us to make, and I am available to address any questions you may have.

Last Reviewed 2010-08-25

BEST Facilitates $1.6M Investment In Green Building Research

03/12/2009

FOR IMMEDIATE RELEASE

Investments at OSU, PSU Expand Research Capacity

PORTLAND, Ore. – The Oregon Built Environment & Sustainable Technologies Center (Oregon BEST) has facilitated a $1.6 million collaborative investment in green building research at two Oregon universities that positions the state to establish a research center of national prominence and offers Oregon's green building businesses access to advanced research tools, expertise and better trained employees.

The investment, at both Oregon State University and Portland State University, funds a network of new, shared laboratories and equipment for developing and testing new green building materials, technologies and entire buildings.

But the investment goes beyond university labs, officials say. It builds a transformative, multi-institutional research model for Oregon that helps fuel the state's economy, improves education and ultimately creates jobs. The shared facilities will serve Oregon's growing green building industry, attract green building companies to Oregon and help the state's universities deepen graduates' experience with green building.

The investment also demonstrates the State of Oregon's unique leadership role in green building research and project execution. "Nobody else is pursuing green building research and development in the multi-institutional way that Oregon is," said David Kenney, president and executive director of Oregon BEST. "This initial investment is the beginning of what will become a center positioned to influence the green building agenda at the national level."

The public-private partnership being facilitated by Oregon BEST creates the opportunity to pursue funding for a federally-funded national research center. A national center located in Oregon would potentially attract millions of research dollars to the state's universities.

"This is what Oregon BEST was set up to do – expand research funding for our state's universities, where faculty can collaborate with companies like ours to develop the next generation of green building materials, technologies and designs," said Dennis Wilde, a principal at Portland, Ore.-based Gerding Edlen, one of the nation's most respected green development companies. "Oregon has an unprecedented opportunity to be the green building capitol of the U.S., and investing in a shared research network will help Oregon seize that leadership opportunity and compete globally with anyone."

Oregon BEST used a portion of its public funding to align additional investment from the Engineering and Technology Industry Council (ETIC), the Miller Foundation Grant Fund at PSU, the Oregon University System and university research offices. Future plans call for expanding the network of Oregon BEST research facilities to other university partners, including the University of Oregon and the Oregon Institute of Technology.

Distributing the investment across more than one university enables Oregon to pool research expertise and equipment, positioning faculty research teams to be more competitive nationally when seeking research funding.

“By working together with PSU, we become much stronger,” said Scott Ashford, head of the OSU School of Civil and Construction Engineering. “By collaborating between campuses, Oregon becomes a force to be reckoned with in the green building sector. This modest investment facilitated by Oregon BEST will enable us to bring in many times this amount of money from outside Oregon.”

The OSU portion of the investment is $920,000, including $400,000 from Oregon BEST, $470,000 from Certificates of Participation (via ETIC), and $50,000 from the OSU Research Office. It establishes the Oregon BEST Green Building Materials Laboratory at OSU, a collaboration between the College of Engineering and the OSU College of Forestry. Research in the shared facility, which will be accessible to and open for research by industry partners, will focus on innovating new green building materials, including: hybrid poplar wood engineered to be three times stronger than old-growth Douglas fir, new types of concrete and pavement that are more durable and environmentally friendly and recycled plastics used as building insulation.

At PSU, the total investment is $651,000, with $218,000 from Oregon BEST, $351,000 from the James F. and Marion L. Miller Foundation (via PSU's Center for Sustainable Processes and Practices) and $82,000 from the Oregon University System.

The funding will establish the Oregon BEST Green Building Research Laboratory at PSU, where researchers from other OUS institutions and industry can use a suite of infrared cameras and thermal characterization equipment to test everything from green roofs and window glazings to interior moisture levels and a building’s surface temperatures. When the equipment is used in conjunction with other federally funded research projects, it will facilitate a broader investigation of the impact of buildings on the urban environment.

Housed in a new LEED Gold building at PSU, the lab will also feature sensing and logging capabilities that can monitor indoor environmental quality and track how buildings respond to a range of activities and conditions, including how occupant behavior impacts building energy use. Some of the sensing equipment will be available to be loaned to industry partners to do onsite testing of new materials and technologies.

“It is great to have Oregon BEST helping facilitate collaboration between the campuses and industry – bringing together the different pieces of the puzzle to create something greater than the sum of its parts,” said David Sailor, a professor in the PSU Dept. of Mechanical and Materials Engineering who will direct the new Oregon BEST lab at PSU. “By working together and collaborating across boundaries, we can start solving bigger problems, and Oregon BEST is key to making that happen.”

The distributed, shared research network model was pioneered in the state by the Oregon Nanoscience and Microtechnologies Institute (ONAMI) several years ago, and has demonstrated significant success in leveraging a relatively small investment into large-scale funding from a variety of federal sources.

Investing in a distributed network of shared facilities focused on green building research enables Oregon to maximize resources and funding to attain national prominence, Kenney said.

“By teaming up and investing funding strategically, we maximize the impact of the research,” Kenney said. “Here in Oregon, we have a tremendous set of university resources and research expertise that most states can’t assemble: world class architecture, engineering, forestry, computer science control systems, energy research and more. When we combine this expertise with the growing concentration of green building professionals here in Oregon, we extend our national leadership position.”

About Oregon BEST: The Oregon Built Environment & Sustainable Technologies Center (Oregon BEST) brings together Oregon’s significant R&D strengths in the key emerging areas of renewable energy and green building products and services, with the goal of increasing research and accelerating public/private partnerships to transform that research into on-the-ground business opportunities and Oregon jobs. Oregon BEST partners include the Oregon Institute of Technology, Oregon State University, Portland State University, the University of Oregon, as well as numerous private businesses, government agencies and non-governmental organizations. http://oregonbest.org

Sustainability

Today’s leading organizations recognize that sustainability is an essential aspect of their business strategies. A broader, more strategic plan for sustainability can not only drive efficiency and innovation across the enterprise, but also satisfy customer needs and influence how their suppliers operate.

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Building Performance and Occupant Satisfaction Tied to Green Investment in New Report

Findings from multi-year study by CB Richard Ellis, McGraw-Hill Construction and the University of San Diego unveiled at Greenbuild

CHICAGO, Nov. 17, 2010 /PRNewswire/ -- At its core, a green building is a better performing building. It uses fewer resources and offers a better place to work through improved energy and water efficiency, better air quality, and access to natural daylight—but do green buildings make dollars and sense for investors? The Business Benefits of Green Buildings SmartMarket Report, released today by McGraw-Hill Construction, CB Richard Ellis (CBRE) and the University of San Diego's (USD) Burnham-Moores Center for Real Estate during the U.S. Green Building Council's (USGBC) Greenbuild Expo in Chicago, says yes.

As the second phase of an ongoing study initiated in 2009 by CBRE and USD, the report offers a comprehensive look at how commercial building owners, managers, tenant firms and occupants perceive the benefits of green buildings and reveals bottom-line and human factor (health and well-being) benefits that are driving green building growth in the U.S. The findings show that sustainable buildings generate stronger investment fundamentals than their traditionally managed competitors.

"The value of green is undeniable—and delivering during a recession," said Harvey M. Bernstein, vice president, Global Thought Leadership and Business Development, McGraw-Hill Construction. "Owners of green buildings consistently report financial benefits, such as 5% building value increase and 4% ROI, as leading motivators for building green. We also found that people care about the health features of green buildings, driven by access to daylight and better indoor environmental quality."

From a financial perspective, owners of sustainably managed buildings anticipate a 4% higher return on investment; 5% increases in building value and occupancy; 8% drops in operating costs; and 1% rise in rental income. Roughly 79% of owners surveyed believe that green helps them attract and retain

tenants, a distinct competitive advantage in a difficult economy. Furthermore, over 70% of surveyed office building owners are already engaged in greening a significant percentage of their portfolio.

"This study underscores the viability of sustainable buildings as smart investments," said Dave Pogue, national director of Sustainability, Institutional and Corporate Services, CBRE. "In addition to the higher occupancy and rental rates we've seen throughout the study's two-year history, the study demonstrates that sustainable practices yield measurably better investment fundamentals. CBRE is proud to work with McGraw-Hill Construction and USD to support greater change within the industry and promote the positive future green building provides."

Greater productivity, satisfaction, health and well-being are also supporting green building growth. 10% of green building tenants have seen improvement in worker productivity, and none reported decreases. Tenant satisfaction increases after green upgrades, with 94% of managers seeing higher satisfaction levels after green projects. But most of all, people care about the health impact of green buildings, including access to daylight and better indoor air quality; 83% of tenants believe they have a healthier indoor environment as a result of green efforts.

"The impact of green on human health and productivity is the holy grail of green building results," Bernstein added. "While this study measures significant benefits perceived today, further measurement is needed to fully capture it. We look forward to continuing to work with CB Richard Ellis and the University of San Diego to track these buildings over time in the pursuit of even more answers."

The largest and longest running study of its kind, this ongoing analysis benchmarks and measures green building benefits and economic outcomes as a framework of investment criteria for retrofit activity. A full update to the 2009 report, Do Green Buildings Make Dollars and Sense?, should be released later this year.

This report follows McGraw-Hill Construction's Green Outlook 2011 Report, which provides a view of the green building market for the past five years and predicts its size in 2015 ($135 billion), and two publications released by CBRE earlier this month, USGBC's *Green Operations Guide: Integrating LEED into Property Management*, a guide that enables building owners and managers to better understand LEED EB: O&M benefits, and *Law Firms Build a Case for Green: Recent Trends in Law FirmSustainability Practices*, which highlights sustainability practices among U.S. and global law firms, including a trend toward pursuing LEED certification, and considers costs versus yield of select sustainable strategies.

The Business Benefits of Green Buildings: Building and Occupant Performance Driving Green Investment in Existing Commercial Buildings SmartMarket Report is produced by McGraw-Hill Construction, with support from premier partner CBRE and its research partner, USD's Burnham-Moores Center for Real Estate. The corporate contributor is Autodesk. The association partner is the USGBC. The study defines a green building as those with LEED certification at any level or those that bear the EPA ENERGY STAR® label. All of the ENERGY STAR® buildings in the survey group have been awarded that label since 2008. Most of the buildings included in the research have also adopted other sustainable practices like recycling, green cleaning and water conservation. Visit http://construction.com/market_research to purchase a copy of the report. More information is available at McGraw-Hill Construction's Greenbuild booth #801, or visit CBRE at booth #1727.

About CB Richard Ellis:

CB Richard Ellis Group, Inc. (NYSE: CBG), a Fortune 500 and S&P 500 company headquartered in Los Angeles, is the world's largest commercial real estate services firm (in terms of 2009 revenue). The company has approximately 29,000 employees (excluding affiliates), and serves real estate owners,

investors and occupiers through more than 300 offices (excluding affiliates) worldwide. CBRE offers strategic advice and execution for property sales and leasing; corporate services; property, facilities and project management; mortgage banking; appraisal and valuation; development services; investment management; and research and consulting. Please visit our Web site at www.cbre.com.

CBRE was recently ranked #30 among *Newsweek*'s greenest companies in America, and #1 among the financial services sector. The U.S. Environmental Protection Agency has named CBRE an ENERGY STAR® Partner of the Year for the past three years, including recent recognition for Sustained Excellence. The U.S. Green Building Council has awarded CBRE its Leadership Award for Organizational Excellence and the industry group, CoreNet, recognized CBRE with a special commendation for Sustainable Leadership and Design Development.

About McGraw-Hill Construction:

McGraw-Hill Construction connects people, projects and products across the construction industry. For more than a century, it has remained North America's leading provider of project and product information, plans and specifications, and industry news, trends and forecasts. McGraw-Hill Construction serves more than one million customers in the $5.6 trillion global construction industry through Dodge, Sweets, *Architectural Record, Engineering News-Record*, *GreenSource*, and *SNAP*. To learn more, visit www.construction.com or follow @mhconstruction on Twitter.

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About University of San Diego's Burnham-Moores Center for Real Estate:

Founded in 1993, the University of San Diego's Burnham-Moores Center for Real Estate is committed to delivering outstanding education, industry outreach, career and research services to advance socially responsible leadership in the real estate profession. As part of the University's School of Business Administration, the Center offers a Master of Science in Real Estate degree, an undergraduate minor in real estate, a Certificate in Real Estate Finance, Investments and Development, a Certificate in Land Use and Sustainable Community Development and several major industry conferences throughout the year. For more information, visit www.usdrealestate.com.

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26 Aug 2010: Investment Pay-Off Of Green Buildings

Bottom-line benefits like consistent increases in gross rentals, lower operating costs and less capital expenditure over a building's life-cycle are three key reasons whyproperty investors are embracing green buildings around the globe.

And at the third annual Green Building Council of SA (GBCSA) Convention & Exhibition to be held in Cape Town next month, those investment benefits of green buildings will be in the spotlight – and under scrutiny – for South Africa's property investment community.

"The economic benefits and financing of green buildings are high on the agenda for investors as well as for built environment professionals," says GBCSA CEO Nicola Douglas.

A respected sustainability expert Lisa Michelle Galley, managing principal at San Francisco-based Galley Eco Capital, a green real estate finance consultancy, will be one of the international speakers at the Convention.

She will tackle the topic of The Global Real Estate Game Change: Positioning Portfolios for Success and make a financial case for property investors to go green. Galley will also be facilitating a more detailed seminar on the Fundamentals of Green Building Investment Analysis, which is aimed specifically at commercial property investors, developer and financiers, and takes place on the Monday preceding the main Convention programme.

Galley uses no less an example than the Empire State Building in New York to illustrate her point.

"Tony Malkin, who owns the building, said at a conference recently that building is achieving a 38 percent Return on Investment on its retrofit measures," she says.

"He also highlighted the fact that the property now attracts a whole new segment of brokers and tenants – in addition to the ones who were always interested in the building."

For investors who are still skeptical, Galley points to three features of green buildings, confirmed by research that has universal appeal to property owners, whether in SA or elsewhere.

First, green buildings consistently show above average increases in gross rentals.

She points to faster take-up rates, a reduction in turnover vacancy rates, and higher retention rates of existing tenants.

“That translates into lower tenant installation costs on new leases.”

Second, green buildings have lower operating costs. Utility costs, maintenance expenses and insurance costs all tend to be reduced in energy-efficient and sustainably-managed buildings.

“Investors find that improved green operations and maintenance protocols mean fewer service calls from tenants,” she adds.

Third, green buildings require less capital expenditure over the building lifecycle, taking pressure off theproperty investor’s cashflow.

“Not only do investors reap the savings of more efficient systems, those systems also last longer and don’t need to be replaced as frequently,” she explains.

The bottom-line, she says, is that tenants prefer green buildings – something that landlords are quickly realizing.

“The good news is that some of the most conservative landlords are reporting that their energy efficiency and green building programs are paying big dividends,” she says.

The Convention will be held at the Cape Town International Convention Centre from 20-22 September 2010.

Sector Tags: **Property**, **Conventions**,

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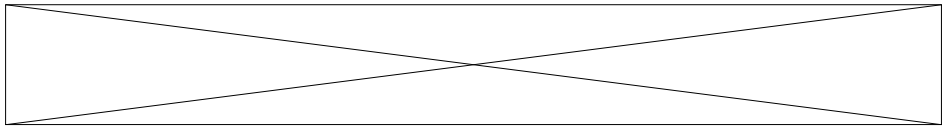

Green buildings

21/1/2010

By Hoong Wey Woon

Hoong Wey Woon on the possible effects that climate change will have on property investment

With the conference on Climate Change in Copenhagen still fresh in minds and investor demand for real estate gradually returning, it is becoming apparent that there is a need for investors like pension fund trustees to understand the impact that climate change will have on real estate.

Indeed, what Copenhagen has reiterated is that sustainability and carbon reduction practices will be themes that drive the political, social and economic agenda for decades.
So what does this mean for real estate and real estate investing? Crucially, property has been estimated to be responsible for between 30-40 per cent of global carbon emissions - so there is a very real opportunity and need for the sector to play a pivotal role supporting a reduction in greenhouse gas emissions and a reduction in building obsolescence over the long-term.

Defining the economic case
Sustainable Investment (SI) can be defined as investment decisions and ownership practices that incorporate environmental and social issues. Although the ethical case for investing in SI property is easily made, the economic case will need to be addressed.

Evidence
To support this, and what increasing evidence and research is showing, is that sustainable real estate investing can help to create brand value and reputation benefits; enhance capital growth and rental income; lower operating costs; improve tenant retention and reduce depreciation costs compared to non-sustainable buildings.

A study by Nils Kok and Piet Eichholtz, called Doing Well by Doing Good: Green Office Buildings of 7,488 US buildings, found that real estate which met certain green building standards generated higher occupancy by 7.5 per cent; higher rents of 6-9 per cent; and 16-17 per cent higher selling prices than buildings that did not meet the green criteria.
Current Opportunities for Investing in Sustainability in the Property Sector (Hall et al), found last year that although there is an initial two per cent higher cost of construction for energy- efficient and sustainable buildings, the financial benefits over the lifetime of the asset outweigh these additional costs through reduced operating costs of 8-9 per cent, increased building values by an average 7.5 per cent and occupancy rates by 3.5 per cent.
Other studies have found that sustainable buildings can save 25-30 per cent in energy costs compared with buildings that do not meet a green building standard, with a payback of three to five years.

These buildings can also provide significant health and productivity benefits (according to the IPF Summary report, McAllister et al., 2009 and Watson and Katz's 2008, Green building impact report). Meanwhile, property consultant GVA Grimley has found that 79 per cent of surveyed occupiers in the finance and business service sector said that they would be willing to pay more for a 'green' building through higher rents. This view is also supported by research carried out by McGraw Hill.

A recent survey by Aviva Investors also found that 95 per cent of UK real estate fund managers perceived there to be a link between environmental practice and financial returns.

How to invest
With the investment and economic case clearly established, the next question is: How can investors access this market? There are numerous ways to

invest in SI equity products, but the investment universe for real estate is much more limited.

The market for SI equity products is well-established. SI equity products make up 17.5 per cent of the total equities asset management industry in Europe having reached Euro 2.7 trillion (about US$3.9 trillion) in 2007. This demonstrates growth of 102 per cent since 2005.

SI equity investment has also delivered financial outperformance. The average SI equity fund outperformed the MSCI World Index by 36 per cent over the last five years.
The SI real estate market, however, is much less mature and the question of which real estate products incorporate SI principles needs to be addressed. Looking at the UK market there is no real route for retail or high net worth investors to invest and only a limited market for institutional investors. Institutional investors have the choice of a few pooled fund products such as the igloo Regeneration Partnership (an Aviva Investors Fund).

Companies such as PRUPIM and Hermes have their own internal portfolios which adhere to SI principles, although these are not accessible to outside investors.

Demand is growing
Demand for SI real estate investment is growing. For example in the UK, the West Midlands Pensions Authority (one of the UK's largest pension funds) has allocated part of their portfolio to SI real estate investment. Their main objective is to invest in assets that generate consistent and strong returns that adhere to SI and good governance practices.
They are not alone: CalPERS and CalSTRS in the US, the Universities Superannuation Scheme in the UK and VicSuper (an Australian A$3.3 billion superannuation fund which awarded a direct property investment mandate to a fund manager on the basis of the fund manager's sustainability credentials) take this type of investment seriously and engage positively within a SI framework.

Developments to date indicate that there will be increasing demand for SI real estate investment products as investors seek to hold a 'future-proofed' real estate portfolio.

SI's importance to increase
There are strong reasons to believe that SI investment in real estate is here for the long run. Two principal reasons are the political and social will to tackle climate change as well as the potential energy crises.

Real estate will remain a prime target for policy action as the UK's carbon disclosure project will increase institutional investors' awareness of their fiduciary responsibilities to address climate change risk in the built environment.

There is also pressure on tenants and investors to behave in an environmentally and socially responsible way. This has not diminished in the recent economic environment and may have actually increased, by placing more pressure on reductions in energy usage. In addition, as governments find that their resources to tackle these issues are finite, they will increasingly look to the private sector for assistance. Therefore there is strong evidence that SI in real estate is here to stay.

A fiduciary duty to consider
It is without doubt that trustees and investors with interests in real estate have a vested interest in the long-term health of the world and its resources.

If SI investment in real estate can deliver equivalent or superior returns or, at the very least, future-proof one's investment, then it is the fiduciary responsibility of trustees and investors to understand the implications of these issues and to seek economic ways to improve the sustainable assets and funds they buy and hold.

Trustees and investors should consider diverting capital towards investment in sustainable real estate and can help set the agenda of long-term sustainable investment.
By doing this they will be undertaking their fiduciary duty to protect the long-term financial futures of their members and investors.

Hoong Wey Woon is a real estate fund manager at Aviva Investors

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oStar Study Finds LEED, Energy Star Bldgs. Outperform Peers

Finally some real data on LEED related ROI:

CoStar Study Finds LEED, Energy Star Bldgs. Outperform Peers

Demand in Marketplace for Sustainability Creates Higher Occupancy Rates, Stronger Rents and Sale Prices in 'Green' Buildings

A new study by CoStar Group has found that sustainable "green" buildings outperform their peer non-green assets in key areas such as occupancy, sale price and rental rates, sometimes by wide margins.

The results indicate a broader demand by property investors and tenants for buildings that have earned either**LEED®** certification or the **Energy Star®** label and strengthen the "business case" for green buildings, which proponents have increasingly cast as financially sound investments.

According to the study, LEED buildings command rent premiums of $11.24 per square foot over their non-LEED peers and have 3.8 percent higher occupancy. Rental rates in Energy Star buildings represent a $2.38 per square foot premium over comparable non-Energy Star buildings and have 3.6 percent higher occupancy.

And, in a trend that could signal greater attention from institutional investors, Energy Star buildings are selling for an average of $61 per square foot more than their peers, while LEED buildings command a remarkable $171 more per square foot.

Andrew Florance, president and CEO of CoStar, called the findings a "strong economic case for developing green buildings" at a seminar hosted by the District of Columbia Building Industry Association (DCBIA) where he presented results from the study this month.

"The information we've discovered is very compelling. Like all good science, we discovered it by accident," Florance said. "Green buildings are clearly achieving higher rents and higher occupancy, they have lower operating costs, and they're achieving higher sale prices."

Florance conducted the study with Jay Spivey, CoStar's director of analytics, and Dr. Norm Miller of the Burnham-Moores Center for Real Estate at the University of San Diego. The group analyzed more than 1,300 LEED and Energy Star buildings representing about 351 million square feet in CoStar's commercial property database of roughly 44 billion square feet, and assessed those buildings against non-green properties with similar size, location, class, tenancy and year-built characteristics to generate the results.

"We wanted to take each and every one of these green buildings in our database and compare them to the buildings they directly compete with in the submarket," Florance said at the seminar.

One factor for the "green" premiums would appear to be the constricted supply of green buildings, which account for just a fraction of the total U.S. building stock (less than 1 percent of space in CoStar's database.) The study indicates that while the number of LEED-certified and Energy Star buildings continues to grow, the supply has not kept pace with demand.

CoStar began tagging green buildings in its database about two years ago with the help of the U.S. Green Building Council (USGBC), the nonprofit trade group that created the LEED certification system, and the U.S. Environmental Protection Agency (EPA), which administers the government-sanctioned Energy Star label.

Although often lumped together under the 'green building' moniker, LEED and Energy Star address distinct -- if not related -- goals.

LEED, which stands for Leadership in Energy and Environmental Design, indicates a property's overall sustainability by awarding points for just about any sustainable feature imaginable, from bike racks and rainwater collection and reuse systems, to energy-efficient lighting and low-flow plumbing fixtures. It is comprised of specific programs tailored for new buildings, existing buildings and tenant build-outs, and awards different tiers of certification such as Silver, Gold or Platinum, the highest.

Over the past few years, LEED has emerged as the industry's de facto sustainable property rating system and become nearly synonymous with the term 'green building'. So much so, "There's a bit of urgency now that the value of buildings could be affected if they are not LEED-certified," says Mark Bennett, a senior attorney with law firm Miller Canfield who specializes in green building and climate change issues.

Bennett recently chaired the National Green Building Finance and Investment Forum, a conference involving financial sector and property investment leaders in San Francisco, where he says LEED was a matter of discussion for many of the nation's top institutional investors. "In large part, they were referring to LEED certification as a component in the definition of a Class A office building," he said. "They basically said, 'If you're building today without LEED, you're building in obsolescence.' "

Many would pitch the same argument for EPA's Energy Star program, an energy-benchmarking tool and a flag for the nation's most energy-efficient properties. The program bypasses the bells and whistles of LEED by targeting simpler strategies such as installing energy efficient windows, turning off computers at night and adding motion sensors to control lighting, to great effect: buildings that have earned the Energy Star label use an average of almost 40 percent less energy than average buildings, and emit 35 percent less carbon.

In fact, according to EPA, as many as 500 buildings out of the 4,100 or so total commercial buildings that have earned Energy Star use a full 50 percent less energy than average buildings. And many of those efficiency practices, such as upgrading light bulbs or office equipment, pay for themselves in energy cost savings.

On top of that, premiums that the market is willing to pay for Energy Star buildings, as indicated in the CoStar study, are a clear demonstration of the overall impact of energy efficiency on property value, says Stuart Brodsky, national program manager for the Commercial Properties division of Energy Star.

"The business case for energy efficiency is indisputable," Brodsky told CoStar. "The business case is so strong that the financial results can be applied to asset value, through increased NOI [net operating income], or leveraged to pursue other aspects of green buildings that do not show as strong of a financial rate of return."

But the benefit of Energy Star extends beyond asset value. Aside from the actual Energy Star designation, which owners may choose to pursue by demonstrating energy reductions, the program also serves as a stand-alone energy benchmarking tool: an energy report card, so to speak, and the type of environmental transparency in the industry Florance has routinely called for.

"For a lot of people, it's where the rubber meets the road," Brodsky says of the benchmarking aspect, which saw participation jump by more than 175 percent from 2006 to 2007. To date, almost 8 billion square feet of U.S. property has been benchmarked through Energy Star.

One sharp contrast between Energy Star and LEED is where the responsibility for implementation falls. With LEED, where three-fourths of all certified projects to date fall under the program's flagship brand -- LEED for New Construction (LEED-NC) -- the burden for certification is largely on architects and engineers at the design stage.

But with Energy Star, which looks exclusively at energy consumption in existing assets, responsibility shifts to property managers. Demand for Energy Star buildings is a "quantifiable indicator of superior management practices across the property, which may otherwise be intangible," Brodsky says.

Other contrasts are closer to the surface. Energy Star is often seen as just one piece of the sustainability puzzle, while LEED buildings, especially those certified under LEED-NC, don't always correlate to high levels of energy efficiency (USGBC has, perhaps in response, re-tooled its building operations platform, LEED for Existing Buildings (LEED-EB)).

But in many ways, those differences have benefited both programs, allowing them to serve the same customers without becoming direct competitors. Several big commercial real estate service providers, including CB Richard Ellis and Transwestern, run Energy Star and LEED programs concurrently across their managed portfolios.

So does Kennedy Associates Real Estate Counsel LP, an Energy Star partner since 2005 and one of only a handful of U.S. institutional investment advisors recognized as an early adopter of green strategies.

"We think of Energy Star and LEED in concert with each other," says Bob Ratliffe, an executive vice president of portfolio management with the Seattle-based firm, which also has broad development operations. "LEED and Energy Star come up in every investment we make, they come up in the investment committee, they come up in asset management committee meetings. Both are part of our fabric."

Under its Responsible Property Investing (RPI) platform, which promotes energy conservation, sustainable development and responsible contracting across its portfolio of more than $9 billion in assets under management, Kennedy's LEED and Energy Star activities are extensive. It has about $325 million in LEED-certified assets, as well as another pool of buildings valued at around $1.5 billion that are either pre-certified for LEED or planned for certification. In addition, the firm recently identified more than 45 office buildings for enrollment in the LEED-EB portfolio pilot program.

Its portfolio also includes 35 Energy Star-labeled buildings, a number that includes more than 60 percent of all Energy Star-labeled warehouse facilities to date. The firm's benchmarking efforts currently include more than 160 buildings totaling 22 million square feet of office and industrial space.

Kennedy says it sees higher occupancy and rent rates, as well as quicker lease-up and better tenant retention, in its LEED and Energy Star buildings due to a number of factors, including market demand. "If we lease buildings faster and hang on to tenants longer, that adds to the economic equation," says Preston Sargent, an executive vice president and principal with Kennedy who oversees the firm's largest client, the Multi-Employer Property Trust (MEPT).

"And obviously, if you're selling a building at a lower cap rate, that's additional icing on the cake," he said.

But the benefits extend beyond that, Ratliffe says. "Our investors recognize we are a national leader in [sustainability] and put a value on that. And as they assess their advisors, they see the leadership we're taking in RPI and give us points, if you will, as they assess us amongst our competitors. And that's good for business," he said.

In large part, Kennedy is able to balance Energy Star and LEED because the programs fit well with each other. "They're complementary," says Christian Gunter, a LEED-Accredited Professional and assistant vice president of Kennedy's RPI program, who points out that LEED-EB buildings must achieve a certain Energy Star score as a prerequisite for certification.

"In a recessionary environment there's more than one way to cut costs," Ratliffe says, referring to the energy and operational efficiencies emphasized under Energy Star and LEED-EB. "It's not just cutting employees."
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Investing in Green Building

By: **Energy and Capital**

Posted on

Energy and Capital editor Jeff Siegel reveals 3 publicly traded companies in line to receive an avalanche of contracts, thanks to California's latest Green Building mandate.

You've read it many times before in these pages...

Despite the environmental benefits of green building, it is primarily the proven economic benefits that are moving the industry from niche to mainstream.

Here's a perfect example of what I'm talking about:

The California EPA Headquarters Building in Sacramento—with systems calibration, monitoring, and maintenance for energy performance—delivers annual savings of nearly $200,000. And after-hours heating and lighting controls as well as the building's exterior lighting systems add another $110,000 of yearly savings.

Just these few efficiency and conservation upgrades have resulted in a savings of more than a quarter of a million dollars per year for that one building!

And those don't even include the annual savings from:

- Grounds management
- Water-efficient landscaping
- Elimination of garbage can liners
- Collection of recyclables
- Occupant recycling

Overall, $500,000 was invested in efficiency upgrades, operations, and employee practices. A total of $610,000 is now generated in annual savings.

The initial investment was recovered in less than one year!

Granted, this is just one example. But no matter how you slice it, whether it's $610,000 in annual savings or $6,100 in annual savings, investing in green building pays off.

In fact, just in energy costs alone, green buildings average a 33 percent energy savings compared to conventional buildings.

So while our bloated bureaucrats in Washington argue over how to deal with high energy prices (while trying to preserve their jobs and those huge campaign contributions), we're focusing much of our attention these days on one of the most obvious solutions — green building.

Green Gets Aggressive

Commercial and residential buildings in the United States used 40 quadrillion Btus (quads) of energy in 2005, at a cost of $300 billion. That number is now expected to increase to 50 quads at a cost of $430 billion by 2025.

So it's no surprise that California—a state with a desperate need to beef up its energy infrastructure without crippling its economy—is once again taking the appropriate steps to ensure the state's energy security.

To date, California has adopted the most aggressive energy conservation and efficiency policies in the U.S. Combined with robust investment, the Golden state now saves enough electricity every year to avoid building 24 large power plants (i.e. - 500 MW or more).

In fact, according to a report issued by the California Public Utilities Commission, the average cost of energy efficiency programs is roughly half the cost of baseload power generation.

Back in 2004, California also instituted Governor Arnold Schwarzenegger's Green Building Initiative, which mandates a 20 percent reduction in electricity consumption in state buildings by 2015.

And now, California's at it again.

A few weeks ago, the California Building Standards Commission adopted a green building standards code for all new construction statewide.

The new code takes effect in 180 days. It will be voluntary until 2010, when the code is expected to become mandatory. Essentially they allowed the voluntary period so builders and local governments have time to adapt to the new rules.

The new standards code covers residential and commercial construction. It also includes schools, hospitals and other public institutions.

Some of the code's targets include:

- Energy efficiency
- Water consumption
- Dual plumbing systems for potable and recyclable water
- Diversion of construction waste from landfills
- Use of environmentally sensitive materials, including eco-friendly flooring, paint, and insulation.

Three Green Building Stocks to Watch

Certainly consumers benefit from the implementation of aggressive green building standards because they eventually help stabilize energy costs.

But investors can also benefit, as these standards will provide a flood of contracts for those publicly-traded companies operating in the green building sector.

Just a few include:

- Interface, Inc. (**NASDAQ:IFSIA**) - Green carpet products for both residential and commercial markets.
- Energy Focus Inc. (**NASDAQ:EFOI**) - Ultra-efficient fiber optic lighting systems that reduce energy consumption
- Comverge, Inc. (**NASDAQ:COMV**) - Smart Thermostats that cut heating and cooling bills by 15%

There are also **solar installation companies** that are going to benefit from all of this.

After all, solar will play a major role in power generation for many of these new buildings. And somebody has to install these systems.

All in all, California continues to set the standard for the nation when it comes to transitioning our energy economy. But will the rest of the country catch on?

Absolutely!

The economic benefits of green building are too appealing to ignore. And the next President, regardless of who takes the election, is likely going to institute some kind of federal incentive program that will almost certainly give the green building industry a serious shot of steroids.

It's never been a better time to be a **renewable energy investor**!

To a new way of life, and a new generation of wealth...

Jeff

Green Buildings: Building Owners

 Building Owners	 Property Developers	 Manufacturers & Suppliers
 Energy Services Companies	 Financial Institutions	 Governments

Increasing debt and equity investment flows to green buildings while providing macro-level guidance is central to IFC's sustainability strategy. By encouraging innovation, IFC helps building owners in emerging markets to deliver carbon reductions, lower operating and maintenance costs, and achieve marketplace distinction.

IFC partners with other financial institutions and local banks to make direct investments in the following types of client-owned green buildings, whether new or retro-fitted:

- Residential
- Commercial Office
- Healthcare
- Education
- Retail
- Supermarkets
- Hotels

Green building owners benefit from improved occupancy and lease rates due to more productive work and living environments. They also experience risk reduction from environmental regulations that are becoming more stringent, and avoid obsolescence.

To make the decision to "go green" easier and more affordable, IFC now offers an innovative investment tool for emerging economies. TheIFC EDGE Green Building Certification System enables building owners to discover the best technical solutions for their environmentally friendly buildings without the need for expensive building specialists. Green buildings owners certified by EDGE can feel confident that they have achieved a universal standard of excellence.

Today, green buildings offer the single largest global opportunity to make deep emission cuts at low or even negative cost. This is especially true in countries with high CO_2 from buildings, steep cost of electricity, and accelerating urbanization.

Building owners face a real danger of locking in inefficiencies for decades if their buildings are constructed unsustainably. IFC invites these owners to join us in the creation of a global best practice for green buildings.

Project example:

- In 2009, IFC supported the Coco Ocean Resort & Spa, in The Gambia, the first dedicated spa resort in West Africa. The owners' strong commitment to environment, health, and social matters, together with high-energy costs in The Gambia, made energy conservation a priority. Coco Ocean's

use of creative and sustainable design to minimize energy and water consumption and maximize cost savings is a great example of green building design in the tourism sector.

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CBRE Study Finds Green Buildings Investment Advantage

Friday, October 21, 2011

Environmentally-sustainable buildings generate a stronger return on investment, according to a national study of green buildings by CBRE Group and cited in **THIS ARTICLE** from Greenbang. The study, which has tracked about 150 CBRE-managed LEED-certified buildings over three years, found that they enjoy a 3.1 percent advantage in rental rates and occupancy over standard buildings.

Once a green building is built, an essential part of continuing green operations is waste recycling. Recycling spent fluorescent lamps, ballasts, batteries, and electronics can be cost-effective, is important to protecting the environment from hazardous materials like mercury, and can even generate bottom-line benefits like positive green PR and reduced facility liability.

The **EASYPAK™ PREPAID MAIL-IN PROGRAM** makes it simple to recycle these wastes--and prove and publicize recycling efforts--with easy-to-use containers and **ONLINE TOOLS** like Recycling Reports and official Certificates of Recycling.

Learn more » **EASYPAK™ RECYCLING CONTAINERS**
Read more » **CBRE RECYCLING WITH EASYPAK**

*posted by Daniel at **12:28 PM***

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Sustainability: The Great Differentiator

Friday, September 23, 2011

When a business thinks about going green with its facility operations, an important question is "How much will it cost?" Despite the upfront expenditures that facility greening can require, a growing body of evidence demonstrates that in addition to environmental benefits, sustainable commercial buildings make good business sense, too, according to **THIS ARTICLE** from FMLink.

Difficult economy aside, green operational techniques such as implementing high-efficiency lighting systems and fluorescent lamp recycling programs can generate a financial return in the form of energy savings and a polished "green" image. **READ FULL ARTICLE »**

LampRecycling.com's **EASYPAK™ MAIL-IN CONTAINERS** make it simple to go green by recycling spent fluorescent lamps, ballasts, batteries, and electronic waste. Learn more » **EASYPAK™ RECYCLING CONTAINERS**

INVESTING IN SUSTAINABILITY

Stanford invests in sustainability through a broad range of initiatives: research and education, efficiency improvements in existing buildings, advanced conservation systems in new buildings, new technology demonstrations, student-led projects and financial policies that support sustainability. Below are examples of projects and policy initiatives that highlight Stanford's commitment to sustainability.

INITIATIVE ON THE ENVIRONMENT AND SUSTAINABILITY

The university is raising $250 million for the Initiative on the Environment and Sustainability to support interdisciplinary research and teaching across the university. Part of The Stanford Challenge, this major campus-wide effort aims at seeking solutions to the world's most pressing problems and educating students for leadership in the 21st century. Stanford is working to raise $4.3 billion over five years to advance these goals. Learn more at the Stanford Challenge website.

STUDENT GREEN FUND

Established in 2008, this fund provides grants for projects with direct student involvement that will help create a more sustainable campus. A total of $20,000 is available per academic year. See Student Green Fund for details.

EXISTING BUILDINGS

The university has allocated $15 million for major capital improvements to the most energy-intensive buildings on campus.

The Energy Conservation Incentive Program rewards schools and administrative units for saving energy—rebates totaled $830,000 by the end of the program's third full year.

The Energy Retrofit Program has invested more than $10 million over 15 years in improving energy efficiency through technology upgrades. See Energy Initiatives for details on these and other programs.

NEW CONSTRUCTION

All new buildings and most major renovations must meet Stanford's Guidelines for Sustainable Buildings, which adapt the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) system and the U.S. government's Labs21 guidelines to the university setting. Base capital budgets include funding to meet these standards; project leaders can pursue higher standards through special funding.
Among the projects receiving special funding are the Science and Engineering Quad 2 development, including the new Jerry Yang and Akiko Yamazaki Environment + Energy Building; the upcoming Knight Management Center, the new home of Stanford's Graduate School of Business; and Leslie Shao-ming Sun Field Station at the Jasper Ridge Biological Preserve. See Green Buildings for project details.

UTILITY SUPPLY

The university is running solar energy demonstration projects throughout the campus.See Energy Initiatives for details.

SUSTAINABILITY WORKING TEAM ON ECONOMY

This team analyzes environmental sustainability issues that may arise in the areas of endowment transparency, investment priorities and shareholder engagement, and makes recommendations to campus leaders.

ADVISORY PANEL ON INVESTMENT RESPONSIBILITY

In 1971, the Stanford Board of Trustees became the first governing body of a major academic institution to adopt a statement on investment responsibility and created the Commission on Investment Responsibility, later renamed the Advisory Panel on Investment Responsibility (APIR). Find out about the panel's work at the APIR website.

FINANCIAL POLICIES

Stanford has established financial policies related to environmental and equitable aspects of sustainability, including living wage and sustainable purchasing policies.Learn more at the Policies and Initiatives website.

ur Bottom Line

By Doug Gatlin / U.S. Green Building Council

You can afford to build green: The true cost is much lower than you think

Send to a friend!

Evidence that green buildings do not have to cost a penny more than their conventional counterparts continue to pile up, as do the studies that validate significant ongoing operational cost savings for both new and existing green buildings. And these studies are extending beyond time and material into such factors as building valuation, and health and productivity of building occupants.

The most commonly cited reason for building owners and operators not going green is the perceived higher first costs. A 2007 study by Davis Langdon notes, "It is clear from the substantial weight of evidence in the marketplace that reasonable levels of sustainable design can be incorporated into most building types at little or no additional cost. In addition, sustainable materials and systems are becoming more affordable, sustainable design elements are becoming widely accepted in the mainstream of project design, and building owners and tenants are beginning to demand and value those features."

Managers of LEED-certified buildings regularly report energy and water

savings between 30 and 50 percent over their noncertified counterparts.

In fact, key players in real estate and construction regularly misjudge the costs and benefits of green buildings, a new study by the World Business Council for Sustainable Development (WBCSD) reports.

Respondents to a 1,400-person global survey estimated the additional cost of building green at 17 percent above conventional construction, much higher than the true cost difference of about 1 to 2 percent. At the same time, survey respondents estimated buildings' greenhouse gas emissions at 19 percent of world total – half the actual number of 40 percent.

While experienced users of the Green Building Council (Leadership in Energy and Environmental Design) LEED Green Building Certification System are finding it possible to build at Silver and Gold LEED levels for the same cost as conventional buildings, most studies are finding that certification adds only 1 or 2 percent of the overall budget to the construction cost. LEED registration and certification fees are negligible, averaging around $3,000 to $5,000 per project, depending on size and whether it is a new or existing building. (New construction requires more information to be reviewed by USGBC, so the fee is slightly higher than for existing buildings.) Registration is essential for projects pursuing LEED certification and provides access to a variety of resources, including LEED Online, a project management tool that teams use to prepare documentation.

Investments in building commissioning, energy modeling and additional professional services pay dividends as risk mitigation strategy for owners. In fact, building commissioning (a quality control process ensuring that all HVAC, plumbing, electrical and security systems are operating as intended) provides one of the most cost-effective ways to ensure lower energy use and cost once the building is operational.

According to Texas A&M University, the commissioning process typically reduces energy costs in existing buildings by about 20 percent, compared to buildings that do not go through routine commissioning. While these might add to the project budget, they end up saving money in the long run and are also best practices for building design, construction and operations.

When Adobe Systems Inc. earned platinum LEED certification for its existing headquarters complex in San Jose, California, which company leaders thought was already high

performing, they were surprised to learn that some of the building systems were not running as efficiently as they could. By pursuing LEED certification, they uncovered energy waste, subsequently saving over a million dollars annually. In fact, modifications to the programming of a garage fan alone reduced energy consumption enough to save $98,818 yearly without sacrificing air quality!

Savings From Ongoing Operations

Once the project is operational, buildings recoup added costs within the first one to two years, a blip compared with the typical lifespan of a building, which can often exceed 100 years. LEED-certified buildings use significantly less energy and water than a conventional building. Managers of LEED-certified buildings regularly report energy and water savings between 30 and 50 percent over their noncertified counterparts, yielding large savings in operational costs.

But beyond the obvious implications of reduced utility costs, the business case for green buildings as financially sound investments is strengthened when you consider LEED-certified buildings' increased worth. Several building projects recently submitted to USGBC show an average savings of more than $1.50 per square foot in operational expenses as a result of management improvements and equipment upgrades conducted to earn LEED certification. In investment properties, this translates into an attractive increase in net operating income (NOI) that delivers increased profitability year after year.

The role of green building practices and features is boosting the value of real estate and has appraisal experts taking notice. According to Theddi Wright Chappell, the managing director and national practice leader of National Green Building & Sustainability Practice Valuation Services for the Capital Markets Group of Cushman & Wakefield of Washington, Inc.: "There is no doubt the market is looking more closely at issues such as energy efficiency and a building's carbon footprint in making investment decisions. Buildings that do not measure up in these two areas alone are losing favor among investors and in many instances are being considered less attractive investments long term. Even though data may not currently exist to

prove up a value premium for sustainable properties, there is a growing belief in the valuation community that if a building is not energy efficient and high performing, there is a much greater likelihood its value will be discounted in the coming years."

Overall, building a new building or upgrading an existing building to LEED standards offers a remarkable return on investment (ROI). Cost-benefit analysis on 10 buildings recently awarded LEED certification shows an average ROI of 29 percent for green investments. How's that for the bottom line?

The Other Side of the Equation

One of the costliest aspects of a building is the health of the people inside. A study conducted in 2000 by the Harvard School of Public Health and the Polaroid Corporation found that employee absences cost companies billions of dollars annually. In a study by William Fisk, green buildings were found to add between $20 billion and $160 billion in increased worker productivity every year. According to many facility managers overseeing LEED-certified buildings, these buildings yield significant productivity and health benefits, including heightened employee productivity and satisfaction, fewer sick days and less turnover. Case studies further demonstrate that employees who work inside the buildings are more productive and report greater satisfaction with their workplaces, specifically identifying sunlight, views of nature and heightened thermal and acoustic comfort.

Other Strategies

The most effective way to reduce higher costs is by getting an experienced project team in place and practicing the principles of integrated design. Integrated design engages users and operators during the design process so projects are able to integrate better design and understanding of building features and functions.
To stay on track, according to Davis Langdon's study:

Begin documentation early and maintain it as you go. Update and monitor the LEED checklist regularly so you have a clear picture of your progress. Use energy- and cost-modeling tools to drive decisions at the design phase, not to validate decisions at the construction phase. The best response to the question, "How can you afford LEED certification?" may well be, "You can't afford not to!"

Existing Buildings

LEED has been a successful tool not only for greening new buildings but for improving the efficiency and healthiness of existing buildings. The commercial buildings market in the

United States is vast and aging. Spanning more than five million individual facilities and comprising 70 billion square feet, U.S. commercial buildings–including offices, retail facilities, schools and public buildings–are on average more than 30 years old. Many could benefit from the use of green operations and maintenance strategies addressed in the new LEED for Existing Buildings: Operations and Maintenance (O&M) certification system.

Launched in January 2008, LEED for Existing Buildings: O&M is a tool for maximizing efficient operations in existing buildings. It identifies and rewards best practices across the spectrum of building management issues, including energy and water efficiency, resource conservation, recycling, environmentally preferable purchasing and green cleaning. LEED for Existing Buildings: O&M also serves as an outline for implementing improvements and provides a reference to the technologies and strategies that help you on your journey toward sustainable facilities operations.

USGBC also provides independent third-party verification of green performance levels in buildings that pursue LEED certification. Prevalent in the new construction arena, LEED certification is now gaining popularity among existing buildings, as owners seek to quantify the performance of their buildings in a range of key areas such as carbon emissions, sustainable site management, water conservation and indoor environmental quality.

LEED for Existing Buildings: O&M is the result of major revisions to the LEED for Existing Buildings certification system, which was first launched in 2004. The new version has a clearer focus on green operations as opposed to construction, making it a more useful tool for implementing sustainability across the board in an organization's facilities. The other goals of the new system are streamlined reporting requirements for earning LEED certification, and increased focus on measured environmental outcomes.

The journey toward sustainability begins with creating a plan for improving existing facility

performance and operations practices. The collection of measures, known as credits in the LEED for Existing Buildings: O&M certification system, can be used as the basis for this plan. This can be done at the level of a single building or can be applied to dozens or even hundreds of buildings across a portfolio. LEED for Existing Buildings: O&M includes credits that address green cleaning, materials and resources, energy and water efficiency, and indoor environmental quality. Many of the items can be implemented quickly at no cost and will garner immediate environmental benefits. Others can be implemented over time as part of a comprehensive upgrade plan. To learn more about LEED for Existing Buildings: O&M, visit www.usgbc.org.

Facilities Management ;Finance;Green Building;

Can Green Buildings Pass Payback Tests?

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By SAQIB RAHIM,
Published: February 27, 2009

It's been sold as the ultimate no-brainer climate investment: Make a building that's more energy efficient, and you'll pocket the savings while avoiding harmful emissions.

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With buildings accounting for 40 percent of the country's greenhouse gas emissions, the "green" building has also gotten a look from Obama administration policymakers hoping to shrink the nation's carbon footprint.

Now a group of builders has issued a report arguing that the green-building vision may be more of a myth. You can make a building more energy efficient, the group says, but it won't come cheap, and it could take decades to pay off.

The report, released this week by the Commercial Real Estate Development Association, found that a 50 percent energy improvement beyond federal standards is technically impossible. A 30 percent target is achievable, but only by adding a million-dollar solar system that could take up to 100 years to pay for itself.

Experts say it is one of the first efforts they have seen to question whether the green building's economic foundation is as solid as advocates claim.

The association, which represents developers of office buildings and other commercial properties, goes by its former acronym, NAIOP. John Bryant, a lobbyist for the group, said he wants the report to wake up policymakers who are considering a big hike for building energy codes.

"Some of the language that's been used in mandate proposals might not be as achievable as people have said," he said. "We don't want to stop the debate -- we want it to move forward; we just want to add some economic data to it."

Prompt paybacks in Chicago, but not in Baltimore

The report used a Department of Energy computer model to simulate how an imaginary, four-story commercial building would fare in three different U.S. climates: Chicago, Baltimore, and Newport Beach, Calif. In each case, the building was given features like insulation, low-leak windows and high-end heating and cooling equipment.

The goal was to make each building 30 to 50 percent more efficient than the current federal standard covering most buildings, ASHRAE 90.1-2004. NAIOP said this is a target commonly backed by efficiency advocates. ASHRAE, an association of building engineers, has sought a 30 percent improvement for commercial buildings by 2010.

Then the efficiency fixes were added up for cost, and that was compared against electricity prices to figure out how long it would take to pay off the "green" features of the building.

The study's finding: too long.

The best-performing building flourished in wind-frozen Chicago, where energy use was shaved 23 percent, for a payback time of nine years. The other two buildings, however, couldn't save more than 22 percent of their energy, and payback took more than 11 years -- too long to interest developers, NAIOP said.

The numbers can be even more skewed than that, said Ken Sagan, a building codes analyst for the National Association of Home Builders. Sagan, who used to own a heating and air-conditioning company, said that when he considered adding a wind turbine to his zero-energy home, he realized that its cost -- $175,000 -- would take 25 years to pay off in utility savings.

Similarly, he said, many technologies that make greener homes can take multiple decades to break even. "Is it practical? Common sense tells you no," he said.

Sagan applauded the NAIOP report, calling its payback estimates "realistic" and labeling it "probably the best report I've seen that is factual and truthful."

The study's results make a marked contrast with the claims of efficiency enthusiasts, some of whom have claimed that new buildings can halve their energy use by next year -- and use zero net energy within a few decades.

Assumptions comparable to those of 'climate deniers'?

Jeffrey Harris, a vice president at the pro-efficiency group Alliance to Save Energy, said these claims have a sturdy foundation in the laboratorys and in the real world. He pointed to the Energy Department's data on high-performance buildings, as well as other databases containing information on existing buildings. Engineers and green-building leaders, he said, "are not breaking a huge amount of sweat in getting beyond 30 percent in code."

He also had major question marks about the NAIOP study. He called the 10-year payback target "an undershot," since the savings of a green building continue as long as it's still standing. He also questioned the report's assumptions about electricity prices and the cost of certain "green" features.

"There's a lot of evidence on the other side," he said. "At the end of the day, you have a single study that has, like any, some shortcomings, and a large body on the other side. ... I kind of compare it to the climate deniers."

Bryant, the NAIOP lobbyist, disagreed. He said commercial building developers routinely make decisions based on a five-to-10-year payback period, and if green buildings broke even that quickly, builders would have erected more.

"We're looking at it from a developer point of view, when maybe some of the other groups aren't," he said.

Congress, meanwhile, has set out in search of the zero-energy commercial building through its 2007 energy bill. The goal is to develop a building by 2030 that uses 80 percent less energy than today's buildings -- and to get the remaining 20 percent of power from renewables like wind or solar.

But builders say these changes are drastic and too rapid, and that code changes need to be more gradual.

The real problem, NAHB says, is the hundred-million-strong body of existing buildings that are as leaky and drafty as ever. Many were built to old codes. Sagan said that is why NAHB was supportive of the White House's recent efforts to weatherize and retrofit homes through the stimulus package.

For more news on energy and the environment, visit www.climatewire.net.

More Articles in Business »

y Aileen Adams, Secretary, State and Consumer Services Agency
"When we build, let us think that we build forever." John Ruskin
Three years ago, Governor Davis issued Executive Order D-16-00, which established sustainable building goals for California state government. Through the leadership of the Sustainable Building Task Force (SBTF), a partnership of more than 40 state agencies, California is now at the forefront of the nation's green building movement. The many remarkable achievements of the SBTF serve as a model for other states, communities, and school districts throughout the country. These accomplishments include:

- Building the first LEED Gold state owned office building in the country, the Education Headquarters Building, which is saving taxpayers $500,000 a year in energy costs alone;
- Including sustainable building performance standards, such as energy efficiency, in over $2 billion of state construction and renovation contracts;
- Finalizing the most comprehensive economic analysis of green building developed to date, The Costs and Financial Benefits of Green Building, which demonstrates that sustainable building is cost-effective;
- Constructing many high visibility state "leadership buildings," which are models of sustainability, including the Caltrans District 7 Office building in Los Angeles;
- Promoting on-site renewable energy, such as the installation of over an acre of photovoltaic panels on the roof of the Franchise Tax Board Building in Rancho Cordova – which is the largest array on any state office building in the country;
- Supporting the University of California Board of Regents in the adoption of a

landmark Green Building Policy and Clean Energy Standard, which will impact over 20 million gross square feet of construction over the next 10 years;

- Assisting the Chancellor of the new 10th University of California campus, UC Merced, in her goal to construct the greenest campus in the country with an initial target of LEED Silver for all construction; and
- Impacting the sustainability of K-12 bond funded school construction throughout the state by providing funding and technical assistance to support the work of the Collaborative for High Performance Schools (CHPS), including the construction of 13 demonstration high performance schools.

This report highlights the efforts of the Sustainable Building Task Force over the past two years. The progress that California state government has made is truly significant. We have witnessed culture changes in the Department of General Services and the Department of Finance -- two agencies with the ultimate responsibility for the integration of sustainable principles into the state's capital outlay process; groundbreaking partnerships among diverse state entities that previously had no interaction; and extensive education to promote sustainability in new infrastructure areas, such as affordable housing, libraries, and historic preservation. While these and the many other Task Force accomplishments would not have been possible without utilizing a team approach, one person deserves special recognition for his extraordinary leadership in the greening of California state government. For the past three years, Arnold Sowell, the Undersecretary of the State and Consumer Services Agency, has provided unwavering vision and support of the Governor's sustainable building goals. His background at the California Integrated Waste Management Board allowed him to help bring together all relevant state agencies and other partners to ensure that California builds the most sustainable buildings possible. He has truly been the glue that held this Task Force together and led it to achieve this remarkable and "sustainable" progress.

I also want to give special recognition to the two Task Force members who co-

authored this report with Undersecretary Sowell: Amanda Eichel and Kathy Frevert. These individuals, in collaboration with all members of the Sustainable Building Task Force, have demonstrated a strong commitment to sustainability in all areas, including buying green, driving green, building green, managing green, and saving green. This team has a remarkable track record in transforming California state government into a national leader in the sustainability arena. TABLE OF CONTENTS

EXECUTIVE SUMMARY

California state government's sustainable building initiatives and programs clearly place the state at the forefront of the nation's green building movement. The state's leadership is evidenced by a diverse range of policy and program accomplishments, including the construction of the nation's first LEED Gold state owned office building; groundbreaking research showing that sustainable building is a cost-effective financial investment; the construction of the 10th University of California campus in Merced that will ultimately be the greenest campus in the world; the adoption by the UC Board of Regents of a systemwide Green Building Policy and Clean Building Standard, which will revolutionize the way the University builds buildings; and the construction of high performance K-12 schools with state school construction bond funds.

Sustainable buildings use key resources like energy, water, materials, and land much more efficiently than buildings that are simply built to code. They create healthier work, learning, and living environments, with more natural light and cleaner air, and are cost effective -- saving taxpayer money. Investing in appropriate sustainable features on the front end of construction, such as dimmable lights and high efficiency HVAC systems, pays off during the life of the building, often many times over.

Two Executive Orders, issued by Governor Davis, launched California on the sustainable building road.

- Executive Order D-16-00, signed in August 2000, establishes the Governor's sustainable building goal: "to site, design, deconstruct, construct, renovate, operate, and maintain state buildings that are models of energy, water and materials efficiency; while providing healthy,

productive and comfortable indoor environment and long-term benefits to Californians."
1
• Executive Order D-46-01, signed in October 2001, provides guidance on the process the Department of General Services will use to locate and lease space, including such considerations as proximity to public transit and affordable housing; preserving structures of historic, cultural, and architectural significance; opportunities for economic renewal; and sensitivity to neighborhood and community concerns.
2
To help implement the Governor's sustainable building goals, the Secretary of the State and Consumer Services Agency, Aileen Adams, established the Sustainable Building Task Force (SBTF), a unique partnership of more than 40 governmental agencies. Members include the California Integrated Waste Management Board, the California Energy Commission, the Department of Health Services, the Department of General Services, the Air Resources Board, the University of California, the Community College system, and the Department of Finance. Over the past several years, this group has worked to use its
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combined building, environmental, and fiscal expertise to integrate sustainable building into the state's capital outlay program, including several nationally recognized projects.
Building Better Buildings: An Update on State Sustainable Building Initiatives (Blueprint 2003) is the first in a series of progress reports on the state's sustainable building efforts. Specifically, the report highlights notable policy and program achievements; describes key Task Force partnerships; provides an in-depth look at several significant sustainable building projects; and details Task Force goals for the coming years.
Some of the Task Force's most significant accomplishments over the last two years include:
• Over $2 billion of current state contracts for capital outlay design and construction projects now include energy efficiency and sustainable building

performance criteria.

- The Education Headquarters Building (Block 225) of the Capitol Area East End Complex became the first state government owned building in the nation to receive the distinguished Leadership in Energy and Environmental Design (LEED) Gold Award from the US Green Building Council in January 2003.
- The pioneering economic analysis report, The Costs and Financial Benefits of Green Buildings, indicates that investing an additional 0 to 2% of a building's construction costs in sustainable building design measures upfront results in savings of 20% or more of those construction costs over the building's lifetime (assumed, conservatively, to be 20 years). In other words, an initial upfront investment of up to $100,000 to incorporate green building features into a $5 million project would result in a savings of $1 million (in today's dollars) over the life of the building. This report, which has attracted national interest, is scheduled for release in October 2003.
- Last year the average energy use in state buildings was reduced by 20%. In particular, energy efficiency at the five building Capitol Area East End Complex exceeds Title 24 energy requirements by over 30% (42% at the Block 225 Education Building), resulting in nearly $500,000 in energy savings annually. Other operations and maintenance best practices in state facilities focus on environmentally friendly cleaning product standards, building material emissions testing, and integrated pest management.
- An acre (50,000 square feet) of photovoltaic panels, the largest rooftop array on any state building, at the Franchise Tax Board Butterfield State Office Building, supplies nearly a half a megawatt (470 kWp) of electricity. This is enough electricity to power more than 400 homes in the Sacramento area.

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- The University of California Board of Regents, with significant input from the Task Force, adopted a landmark, system-wide Green Building Policy and Clean Energy Standard to guide new construction and major renovation projects on the 10 UC campuses. This policy will impact over 20 million square feet of space slated for construction over the next ten years.

- The Chancellor of the University of California Merced, with support from the UC Merced "Red Team" chaired by the Secretary of the State and Consumer Services Agency, established a goal to construct the greenest campus in the country with an initial target of LEED Silver for all construction.
- Over 150 representatives from the public, private and non-profit sectors attended the UC Merced "Conference on Building and Operating Sustainable College Campuses in the 21st Century". The conference was planned in large part by members of the Sustainable Building Task Force and supported by a grant from the U.S. Environmental Protection Agency.
- Thirteen high performance demonstration schools under construction throughout the state serve as models for the integration of high performance features into $15 billion of bond funded school construction projects statewide.
- Five school districts in California, including the Los Angeles Unified School District, have adopted the high performance school construction guidelines established in the Collaborative for High Performance Schools (CHPS) Best Practices Manual. This Manual serves as a national model for high performance school construction and has also been adapted for use by the Federal Department of Energy and the State of Massachusetts.
- The Office of Library Construction included sustainable building design questions in bond funding applications for over $130 million library construction dollars allocated during the first round of funding. Eight library projects, approved during the first funding cycle, will pursue LEED certification.
- The Division of the State Architect launched the Sustainable Schools Website to provide a comprehensive clearinghouse on sustainable school construction issues.
- A Sustainable Facilities category was added to the 2003 Governor's Environment and Economic Leadership Awards, the most prestigious environmental award given by the state.
- The USC Marshall School of Business Women's Leadership Board, a group of undergraduate students (both men and women), worked with the SBTF to develop a business school case study on the organizational process the SCSA used to integrate sustainability into the capital outlay process.
- The Department of General Services established a standard for the use of

environmentally preferable cleaning products in state buildings.
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Even with these major accomplishments, California's path to sustainability is paved with policy considerations and program issues that still need to be addressed. Targets for the coming years include:

- Obtaining a cost-effective LEED Silver level or higher for major state projects;
- Encouraging all school construction projects to use the Collaborative for High Performance Schools criteria to ensure that bond funds are spent wisely on schools that will stand the test of time;
- Publishing and implementing recommendations developed in the economic analysis report, The Costs and Financial Benefits of Green Buildings;
- Working to incorporate in statute the sustainable building policies and programs implemented through Executive Order D-16-00;
- Developing recommendations to establish renewable energy and green power standards for state projects;
- Integrating "total building" commissioning and facility performance evaluations as standard Department of General Services policy for all new construction, infrastructure, and rehabilitation projects to ensure that state buildings continue to operate as designed over time; and
- Adopting performance guidelines to incorporate environmentally friendly practices into facility operations and maintenance.

As we move forward to pursue these and other goals, the Sustainable Building Task Force remains steadfastly committed to improving the state's building process one step at a time, ever mindful of John Muir's observation that:
"WHEN ONE TUGS AT A SINGLE THING IN NATURE, (S)HE FINDS IT ATTACHED TO THE REST OF THE WORLD."
vi

I INTRODUCTION

Two Executive Orders, issued by Governor Davis, launched California on the sustainable building road.

- Executive Order D-16-00, signed in August 2000, establishes the Governor's sustainable building goal: "to site, design, deconstruct, construct, renovate, operate, and maintain state buildings that are models of energy, water and materials efficiency; while providing healthy, productive and comfortable indoor environment and long-term benefits to Californians."

3

- Executive Order D-46-01, signed in October 2001, provides guidance on the process the Department of General Services will use to locate and lease space, including such considerations as proximity to public transit and affordable housing, preserving structures of historic, cultural, and architectural significance, opportunities for economic renewal; and sensitivity to neighborhood and community concerns.

4

To implement these Executive Orders, the Secretary of the State and Consumer Services Agency (SCSA), Aileen Adams, formally convened an interagency Sustainable Building Task Force (SBTF) comprised of over 40 state agencies, including representatives with energy, environmental, fiscal, construction, property management, and historic preservation expertise (Member agencies are listed in Appendix A). The SBTF meets regularly, and the role it plays in coordinating, managing, and guiding the state's sustainable building efforts establishes it as one of the most successful state agency working groups ever initiated.

In December 2001, the SCSA and SBTF released an initial report, Building Better Buildings: A Blueprint for Sustainable State Facilities (Blueprint).

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The Blueprint outlines a ten-point plan to achieve the Governor's sustainable building goals, including recommendations to:

1. Modify the state's capital outlay policies and institutionalize the Sustainable Building Task Force to ensure that the Governor's

sustainable building goals are met.
2. Incorporate life cycle costing, integrated design, commissioning, and post-occupancy evaluation into the state's capital outlay programs.
3. Develop cost-effective building performance, operation, and maintenance standards.
4. Invest additional resources for full-scale implementation of sustainable building practices.

5. Develop comprehensive annual reporting requirements to measure progress in implementing the state's sustainable building goal.
6. Develop leadership buildings to showcase sustainable building practices.
7. Develop sustainable building technical assistance and outreach tools, including a training program for state departments, as well as local government and private sector partners.
8. Create programmatic, fiscal, and administrative incentives to facilitate the implementation of successful sustainable building approaches, including a Governor's sustainable building award.
9. Implement guidelines to acquire leased space with cost-effective sustainable building features.
10. Provide Task Force assistance to other state agencies and departments in key infrastructure areas.

Building Better Buildings: An Update on State Sustainable Building Initiatives (Blueprint 2003) chronicles the state's progress in implementing this ten-point action plan. Blueprint 2003 begins with a brief background section on California's definition of green building, followed by a discussion of policy and program accomplishments. The report then highlights the many public, private, and non-profit partnerships developed by the Sustainable Building Task Force. Finally, it presents a series of case studies, which describe several leadership buildings and a statement of Task Force goals for the next two years. Blueprint 2003 can also be downloaded from the California Integrated Waste Management Board's green building website at www.ciwmb.ca.gov/GreenBuilding/TaskForce.
2

II THE CONTEXT FOR GREEN BUILDING IN CALIFORNIA

Although sustainable building may mean slightly different things to different people, generally speaking, sustainable buildings use key resources like energy, water, materials, and land much more efficiently than buildings that are simply built to code. They are also designed and operated to create healthier and more productive work, learning, and living environments, through the use of natural light and improved indoor environmental quality. From a fiscal perspective, sustainable building is cost-effective, saving taxpayer money by reducing operations and maintenance costs.

There are three green building performance standards, the Leadership in Energy and Environmental Design (LEED) Rating System,
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the Collaborative for High Performance Schools design criteria,
7
and the Labs for the 21st Century Environmental Performance Criteria,
8
each with national application, which currently set the standard for California's green building efforts.

Leadership in Energy and Environmental Design (LEED) Rating System

While there is no universally accepted way to compare the diverse range of green processes and technologies, one standard has gained widespread industry acceptance -- the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) Green Building Rating System.
9
LEED is a nationally recognized sustainable building rating system designed to evaluate new and existing commercial, institutional, and high-rise residential buildings. The LEED system is based on a list of 7 prerequisites and 34 performance based "credits" worth up to 69 points, and divided among six categories, including

Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation & Design.
Four LEED certification categories are possible. Each represents an increasing level of sustainability and number of credits achieved.
LEED Certified 26-32 points
LEED Silver 33-38 points
LEED Gold 39-51 points
LEED Platinum 52+ points
Although LEED was originally developed for commercial projects, new LEED application guides specific to other infrastructure areas and project types are under development. Most notable are: LEED for Campus (addresses the unique needs of a multiple building application); LEED for Existing Buildings (guides the
3

sustainable operation and maintenance of facilities); LEED for Commercial Interiors (specific to major and minor renovations that do not result in significant structural changes); and LEED for Labs (coordinates the Labs21 Environmental Performance Criteria with those developed for LEED). Several SBTF members participate in these LEED committees, which are responsible for developing new LEED applications.
Many states, cities, counties, institutions of higher education, private firms, and non-profit organizations have adopted green building principles. As of August 2003, there were over 3,100 members in the US Green Building Council.
10
With USGBC
membership now extending internationally (there are LEED registered projects in India, China, Canada, and Sri Lanka), LEED is truly the international industry standard for green building.
The Task Force interacts quite extensively with many of these entities through trainings, forums, and USGBC chapter meetings. In particular, the SBTF has taken a leadership role in the development of a Sacramento Committee (SacCom) of the

Northern California Chapter of the USGBC, which held its first meeting in August 2003, and hosted nearly 100 attendees.

IN DEPTH: LEED IN CALIFORNIA

Nearly 20% of USGBC member organizations are located in California,[1] and of over 800 projects registered nationally for LEED certification, nearly 140 of these are located in California,[2] more than in any other state. Within California, the cities of Long Beach, San Diego, San Francisco, San Jose, Santa Monica, Los Angeles Community College District, San Diego Community College District, San Mateo County, and Los Angeles city and county have all made commitments to use LEED for new construction projects. In addition, the city of Oakland, Alameda County, and the University of California system have developed their own LEED-based green building guidelines, and the City of Pleasanton recently passed an ordinance requiring both public and private buildings to meet the LEED Certified level.[4]

Collaborative for High Performance Schools Best Practices Manual

The Collaborative for High Performance Schools, or CHPS, was developed to specifically address the design and construction of K-12 schools in California.[11] CHPS is a diverse group of government, utility, and non-profit organizations that are working to improve the quality of education for California's children. The goal of CHPS is to create a new generation of K-12 public "high performance" school facilities in California -- CHPS design principals also apply to private schools as well as higher education facilities.

CHPS defines "high performance schools" as healthy, comfortable, resource efficient, safe, secure, adaptable, and easy to operate and maintain. Research shows that high performance schools promote higher student test scores, help school districts

retain quality teachers, lower operating costs, increase average daily attendance (ADA), reduce liability, as well as support environmental stewardship and joint use. CHPS developed a three volume Best Practices Manual for High Performance Schools, including a set of building design criteria to "rate" CHPS schools.
12
CHPS
is self-certifying, and CHPS schools must score 28 out of 81 possible points for eligibility. With Task Force support, CHPS is currently completing a fourth volume of the Best Practices Manual, the Maintenance and Operations of high performance facilities, which should be published in early 2004. This manual will not only guide the operations and maintenance of K-12 school facilities, but will provide valuable direction to other state facilities as well.
Although there is currently no interchangeability between the CHPS and LEED rating systems, CHPS is working with the USGBC to develop a Memorandum of Understanding, which would formally establish a partnering relationship between CHPS and the USGBC. CHPS and LEED are very compatible, and Task Force members are working diligently to incorporate both into state programs and outreach opportunities.
5

IN DEPTH: CHPS DEMONSTRATION SCHOOLS
The California Energy Commission, California Integrated Waste Management Board, Investor Owned Utilities, and others contributed resources to fund 13 CHPS demonstration projects throughout the state. These schools are under construction and will be models of energy and materials efficiency, daylighting, and other sustainable features.
Currently, five school districts throughout the state have passed

resolutions adopting the CHPS criteria for all future school construction, including Los Angeles Unified School District, Santa Ana Unified School District, San Rafael City Schools, Coast Community College District, and Dry Creek Joint Elementary School District.
1
In addition, the CHPS Best Practices Manual and Criteria have also been adopted by the state of Massachusetts
2
and the Federal Department of Energy.
3
For more information about CHPS and to view high performance school case studies, please visit: http://www.chps.net.
Laboratories for the 2
st
Century Environmental Performance Criteria
The federal Department of Energy and the US Environmental Protection Agency established the Labs21 program to guide the construction of sustainable laboratory facilities.
13
This program relies upon three components:
1) Partnership Program: The pilot Labs21 Partnership Program includes 15 corporations, universities and government agencies that have committed to taking either a new or existing laboratory facility through the Labs21 process. These pilot partners are in turn provided with technical support and assistance to ensure that facilities are designed to the highest environmental standards possible. The full Labs21 Partnership Program will be rolled out at the October 2003 Labs21 Conference and will then be open to all laboratory facilities throughout the US.
14
2) Training: A full day design course is offered at various locations throughout the country. The course will be offered in two California locations in November of 2003 (San Diego, CA: November 19 and Los Angeles, November 20).
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In addition, Labs21 offers a student design competition, a

phone forum, and a federal laboratories forum.
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3) Tool Kit: The Labs21 Tool Kit includes both information resources and design process tools. In particular, a series of Environmental Performance Criteria (EPC) that closely follow the LEED Rating System, but include provisions to address the more energy and water intensive nature of laboratory facilities, guide the design and construction of sustainable laboratories.
17
In addition to
the EPC, the Labs21 tool kit also includes a design intent tool to guide the commissioning process and a process manual, which is currently under development.
18
The SBTF is working with the UC and other higher education systems to promote the incorporation of Labs21 into the construction of new lab facilities. In particular, the Task Force is interested in the retrofit of existing facilities with energy efficient lamps and “low flow” fume hoods.
19

III POLICY AND PROGRAM ACCOMPLISHMENTS
Over the past two years the Task Force has achieved several significant policy and program accomplishments in such areas as contracting requirements, operations and maintenance, research and development, training and education, on-line resources, and outreach. In addition to implementing new programs, many of these Task Force accomplishments involve new levels of interaction, teamwork, and partnering among diverse state agencies.
The Task Force has not confined its green building activities to state owned and

operated facilities. A concerted effort also has been made to educate private and public sector entities and integrate sustainable building criteria into areas where state resources provide funding for the design and construction of different infrastructure types, including affordable housing, libraries, schools, and laboratories.
$2 Billion in Contract Funds Reflect Sustainable Building Criteria

Sustainable building and energy efficiency criteria are now included in all Department of General Services' Architect and Engineering (A&E) design, construction, and leasing contracts. For example, contracts for new construction and major renovation of state facilities now include criteria specifying that buildings either surpass the Title 24 energy efficiency standard by a minimum of 10% or meet other energy efficiency criteria.
20
To date, $2 billion in capital outlay contracts include these sustainable building and energy efficiency guidelines.
In an effort to simplify and standardize the contracting process, the state recently decided to utilize the LEED rating system in place of existing internal sustainable building and energy efficiency performance criteria.
21
As a result, all significant state projects will soon be required to meet the LEED Certified level, and many projects are targeting even higher levels of sustainability, as set forth in the Goals Section of this report. State leasing contracts also include "sustainable criteria" or guidance specifications. These criteria address indoor environmental quality, and include energy efficiency and construction waste diversion requirements.
To support this new performance guideline, 36 Department of General Services Real Estate Services Division staff have completed the LEED intermediate training course, and 3 staff have subsequently passed the LEED Accreditation Exam and are now registered LEED Accredited Professionals.
22
In addition, four staff in the Waste Board's Green Building Section have received LEED Professional Accreditation.
8

IN DEPTH: STATE PROJECT ACHIEVES LEED GOLD
In January 2003, the Education Headquarters Building (Block 225) of the Capitol Area East End was awarded the LEED
TM
Gold Rating from the US Green Building Council. This is the first state government building in the country to receive a LEED Gold rating for sustainable design. Other notable state buildings seeking LEED certification include Blocks 171-174 of the Capitol Area East End Complex and the Franchise Tax Board Butterfield State Office Building in Sacramento; the Caltrans District 7 Headquarters Building in Los Angeles; and the City Centre State Office Building in San Diego. In addition, the CalPERs Headquarters Expansion Project is targeting a sustainable building goal of LEED Silver. Many of these projects are discussed in greater detail in the leadership building section of this report.
Operations and Maintenance Recogniied as Key to Building Performance

SBTF activities to improve operations and maintenance practices at state facilities are being implemented on several fronts:
Cal/EPA Building: A "LEED for Existing Buildings" Pilot Project
The California Environmental Protection Agency Headquarters Building, a building currently leased by the state from the City of Sacramento, is one of 80 facilities nationally, and 8 buildings in California participating in the LEED for Existing Buildings pilot program.
23
It is anticipated that this building will earn a Platinum LEED-EB rating – the highest level possible. Several new operations and maintenance practices have been implemented in this building with impressive results. For example, savings in energy alone are $100,000 annually, and janitorial complaints have dropped by 70%. Building management reports that due to energy efficiency, water conservation, waste diversion and other changes, its operations and maintenance budget is 82 cents less per square foot than the Sacramento average.
Operations and Maintenance Guidelines Under Development

The SBTF is developing maintenance and operations guidelines for use in state-owned buildings based, in concept, on guidelines already developed by the State of Pennsylvania.
24
Specifically, the state will likely adopt the Green Seal GS-37standard for environmentally preferable cleaning products.
25
Although this standard represents the most rigorous level of environmental
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Strategic Plan for California school districts (K-12 and community colleges), titled, Adopting the Commissioning Process for the Successful Procurement of Schools.
26
With support from the Department of Finance and the Energy Commission's Public Interest Energy Research (PIER) Program, the SBTF is developing an implementation plan to integrate the commissioning process into all future state construction projects. The state's commissioning activities are also being coordinated with the UC System and USGBC to ensure that in-house commissioning efforts will be recognized by the LEED rating system. For more on the state's commissioning efforts, see the California Commissioning Collaborative discussion in the partnership section of this report.
DGS Evaluates Building Occupant Satisfaction
In 2000, the state initiated a Post Occupancy Evaluation (POE), now known as Facility Performance Evaluation, Program.
27
This effort included the creation of a POE strategic plan, followed by an implementation plan in November 2001. Quick response studies, one of five key components of the strategy, were performed on two projects in 2002 -- the Division of Motor Vehicles (DMV) Headquarters, fourth floor renovation and DMV Mission Valley State Office Building.
28
These evaluations identify occupant issues and will serve as a useful tool in improving maintenance services and building performance. Additional evaluations are planned for the Capitol Area East End Complex and the San Francisco Civic Center, as well as other DGS facilities as funding becomes available.
To support facility assessments at the over 1000 school districts throughout the state, the SBTF is developing a POE Toolkit for Schools, which is nearly complete. This self-assessment toolkit will provide teachers with the resources necessary to conduct air quality, light level, and energy efficiency testing of their classrooms and school facilities.

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DGS Buildings Benchmarked
The United States Environmental Protection Agency and the Department of Energy jointly developed the Energy Star Benchmarking Tool for buildings.
29
The Energy Star Benchmarking tool compares building energy use across a national database and ranks buildings accordingly. Because this benchmarking tool ranks buildings nationwide, there is limited consideration of regional variables. In particular, California energy standards as delineated in Title 24 are more stringent than elsewhere in the country.
30
As a result, a California building that achieves a high benchmarking score (indicating eligibility for Energy Star labeling) may not actually be a particularly energy efficient California building.
In order to create a more California friendly Energy Star benchmarking tool, additional California buildings must go through the benchmarking process. Over the last two years, 16 state-owned facilities have been benchmarked using the Energy Star benchmarking tool. Twelve of these buildings have scored 90 or above (75 points are required to achieve Energy Star status). Two additional buildings are currently going through the submission process and one is being audited for eventual benchmarking. Additionally, the SCSA, through the School Energy Efficiency Program, intends to benchmark roughly 200 California K-12 school facilities. Using this additional data, the SBTF will work with the US EPA to refine the Energy Star Benchmarking Program and more thoroughly incorporate its technical assistance tools into the state's operations and maintenance protocols.
Tas Force Initiates Groundbrea ing Research

Because misperceptions still exist about the cost of green buildings and the unproven nature of certain sustainable technologies or practices, the SBTF has initiated a number of studies, demonstration projects, and air quality testing procedures to begin

the process of separating green building fact from fiction.
Economic Analysis Shows Sustainable Building Is Cost-Effective
The Costs and Financial Benefits of Green Building, an economic analysis commissioned by the Sustainable Building Task Force, is the most comprehensive green building cost benefit study completed to date. The results of this study will dramatically increase the nation's understanding of what it really costs to build green. Among other things, the study analyzed the costs and financial benefits of sustainable building at the LEED Silver and Gold levels, and found that a 0 to 2% upfront investment in sustainable design (up to the LEED Gold level) will yield 20% savings over the life of the building (assumed conservatively to be 20 years). In other words, an initial upfront investment of up to $100,000 to incorporate green building features

into a $5 million project would result in a savings of $1 million (in today's dollars) over the life of the building, assumed, conservatively, to be 20 years. The report considers both direct and indirect financial benefits, including values for energy, water and waste reduction, as well as values for the more indirect benefits associated with employee productivity gains and health improvements. Although the total direct and indirect savings associated with greening is significant, direct benefits alone are still three times greater than any additional upfront costs.
In addition, the analysis shows that the incremental cost of building green is decreasing, in particular as project teams gain valuable experience and the demand for green products increase. The final report, which will be available on the SBTF website,
31
also includes recommendations for additional research. Clearly, this report provides those with fiscal and construction expertise a defensible, informed rationale for making sustainable building funding decisions.
Analysis Shows LEED Certified Is Standard State Practice
Although only one LEED project has been completed and a number of additional state projects are currently registered for LEED certification, the

SBTF wanted a clear picture of how standard state building practice measured up against the LEED rating system. Recently, the SBTF completed a preliminary LEED credit analysis to determine the LEED rating of standard state design and construction practice. Findings indicate that with little to no additional cost and/or effort, the state should be able to deliver buildings at the LEED Silver level. This study was conducted primarily for new construction projects in urban areas, however analysis also considered suburban and rural sites, as well as renovation projects.

Report Outlines How to Manage the Cost of Green Buildings

The sustainable building process requires a new way of delivering buildings. More work must be completed upfront to address design issues, energy modeling, and material selection. The SBTF, in collaboration with the Alameda County Waste Management Authority, commissioned a report to identify factors that influence green building costs and provide recommendations on how to best manage these costs. This report, scheduled for completion in October 2003, provides general cost-saving strategies and explores cost management opportunities specific to four building types: laboratories, affordable housing, libraries, and K-12 schools.

Emissions Testing Continues During Occupancy

Prior to building material selection at the Capitol Area East End Complex, manufacturers of materials with indoor air quality implications were required by the design/build teams to submit test results for each product showing that they met the requirements of an environmental specification (known as

Section 01350) developed specifically for this project. After completion of the construction, prior to modular office furniture installation, as well as after the installation of the modular office furniture and prior to occupancy, indoor air sampling for volatile organic compounds (VOCs) and aldehydes, including formaldehyde, was conducted at each of the five buildings. Testing was intended to ensure that the concentrations of the target chemicals were below the concentrations set forth at the beginning of the project by each design/build team. One building (Block 225) was sampled extensively during

the flush-out period as well as after occupancy.
The Indoor Air Quality Section of the Department of Health Services, with funding from the US EPA, is continuing to monitor the indoor air quality of the five building Capitol Area East End Complex. The goal of this 18-month research study is to determine the effects of building materials, office furniture, occupant activities, and cleaning/maintenance products on indoor air quality by measuring indoor chemical concentrations. Collected data will be reported to the Department of General Services, who will, in turn, share this information with the Health and Safety officers of the two Departments occupying the Complex.
Study Considers Benefits of Raised Floors
With the installation of the first Under Floor Air Distribution (UFAD) system in a state building (Block 225 of the Capitol Area East End Complex), the Department of Finance requested that a study be undertaken to quantify the costs and benefits of the UFAD system. The UC Berkeley Center for the Built Environment, a leader in raised floor research, is conducting a field study to determine the positive and negative impacts of underfloor vs. conventional air distribution systems. The study will measure and collect data over a specified time frame at two of the new Capitol Area East End buildings, evaluating energy use, indoor environmental quality, occupant satisfaction and comfort, and operating/churn/life-cycle costs.
32
Study Measures Material Emissions
The Materials Emission Testing Study,
33
conducted by the Department of Health Services (DHS), measured emissions from products common to classrooms and state construction compared to emissions from products categorized as recycled content, low VOC, and/or rapidly renewable. Released in June 2003, the study findings indicate that recycled content materials perform to the same level as standard products; however, both may emit chemicals of concern. The DHS and California Integrated Waste Management Board are working with industry to review testing protocols and assist in improving product performance.
3

Study Evaluates Air Quality in California's Classrooms
Environmental Health Conditions in California's Portable Classrooms
34
is a
comprehensive study of the indoor environmental conditions of portable and permanent classrooms in California. Preliminary findings of the study, conducted by the Air Resources Board and the Department of Health Services, indicate that the indoor environmental conditions of many California K-12 classrooms do not meet relevant guidelines and standards. The report makes a series of recommendations to improve the indoor environmental conditions of California's classrooms, including better compliance with existing worker health and safety regulations, self-assessment of classroom conditions by schools, application of "best practices" such as those developed by CHPS, and better training for school district operations and maintenance staff.
Training, Education, and Outreach Remain Top Priorities

SBTF training, education, and outreach efforts include development of technical assistance programs, on-line resources, conference participation, as well as classroom activities.
2000 Building Professionals Trained
The Department of General Services, in collaboration with the California Integrated Waste Management Board, has trained over 2000 architects, engineers, consultants, planners, designers, state and local government employees, and school facilities personnel on sustainable materials selection, construction waste management, and sustainable design. These efforts began with state employees and have expanded to local government staff in Sacramento, San Francisco, Irwindale, Stockton, Los Angeles and San Diego. As part of this effort, a comprehensive Sustainable Building Training Manual
35
is available at no cost. In addition, DSA, CIWMB, and SCSA together sponsored over 20 high performance school training sessions at locations throughout the state.
Waste Board Contract Provides Technical Assistance

The California Integrated Waste Management Board (CIWMB) selected the firm of Berkebile Nelson Immenschuh McDowell Architects (BNIM) to provide a team of highly specialized sustainable building design experts to assist the Sustainable Building Task Force. Current priority projects include affordable housing design, the use of tire-derived products for appropriate sustainable building applications, and improving the quality of classroom design.
4

Marshall School Develops Business Case Study

The USC Marshall School of Business Women's Leadership Board, a group of undergraduate students (both men and women), worked with the SBTF to develop a business school case study on the organizational process the SCSA used to integrate sustainability into the capital outlay process. To inform the case study development process, the USC students visited Sacramento and conducted a series of interviews with the key players in this "dilemma."

Using these interviews, the students developed a written case study and accompanying video. The case was subsequently presented to a class of students to "solve" the dilemma relying only on the information provided. The Secretary of the State and Consumer Services Agency was involved in the judging of the presented solutions. It is likely that this case will be used in future class discussions and potentially could serve as an educational tool at other business schools across the country.

Library Bond Projects Include Sustainable Features

The Office of Library Construction (OLC), under the direction of the State Librarian, strongly encourages the California Public Library Construction and Renovation Bond Act Fund recipients, to design new libraries or renovate existing libraries according to the sustainable building design concepts advocated by the SBTF.

$200 million in state bond funds are currently available for grants to local jurisdictions for the construction and renovation of public libraries.

36
In December
2002, the first of three series of applications, totaling more than $130 million, were approved.
37
The second application deadlines closed in March 2003 and the
third cycle deadline is set for January 2004. Second cycle applications are currently under review. Although the Library Bond did not explicitly require sustainable building criteria, the State Librarian took several significant steps to ensure that libraries constructed with these funds would be sustainable. For example:

- Information on sustainable building was supplied to all applicants via the Office of Library Construction website (www.olc.library.ca.gov).
- Technical assistance information and workshops contained sustainable building materials.
- Part 2 of the Library Bond application package advises applicants to observe sustainable building in their conceptual designs (including water, energy and material efficiency).

38

- Two books, Energy Management Strategies in Public Libraries

39
by
Edward Dean and Sustainable Library Designs
40
by Johanna Sands,
were commissioned by the State Librarian and are being distributed to grantees and the public to raise awareness of sustainable building.

5

In the first library bond construction cycle, the Board approved 8 projects that are planning to meet Leadership in Energy and Environmental Design (LEED) standards.
A second State Library Program, the California Cultural and Historic Endowment, requires the disbursement of roughly $130 million in Proposition 40 funds for projects of historic and cultural significance. The SBTF plans to

work with the State Librarian to ensure that projects granted funds under this program also incorporate sustainable building systems and technologies, where possible.

On-Line Classes Now Available

Through a partnership between Shasta College, the California Integrated Waste Management Board, and the SBTF, a series of sustainable design courses are under development. The first course, Introduction to Sustainable Design, was piloted nationwide at no charge to participants in early 2003. Over 100 "students" participated in this initial offering, with 50 individuals completing all required assignments. A second free of charge pilot course will be offered in early Fall 2003.

Three additional courses, Sustainable Design: Siting, Energy Efficiency, and Indoor Environmental Quality; Sustainable Design: Construction Waste Management, Materials Selection; and Specifications: Making the Most of Materials Selection in Sustainable Design are based on training sessions developed by the CIWMB and converted to online courses by Christine Flowers, a Professor at Shasta College on loan to the Waste Board. A total of 11 environmental-related, on-line courses are under development, each will be hosted by Shasta College. Students will receive 4 credit hours, and up to 30 students may enroll per course offering. All courses are being designed to meet the AIA's Continuing Education Heath Safety and Welfare credit.

Green Building Website Receives Over 150,000 Visitors

The Sustainable Building Task Force Website,

41

hosted by the CIWMB, received over 150,000 visitors in the past year. This website includes a wealth of information for the novice green builder, as well as those well-versed in this area. Green building events are listed; links to state, federal, and local government green building programs are provided; case studies of outstanding green buildings across the country and within California are presented; and new information is continually added (e.g. historic preservation and affordable housing pages are currently under development).

State Architect Launches Sustainable Schools Website

The Division of the State Architect launched its Sustainable Schools Website

42

in

March 2003, which offers a comprehensive clearinghouse on sustainable school construction. The website includes suggestions on incorporating sustainable building practices into school design; sustainable building guidelines; high

performance school case studies; and links to relevant incentive information and school design training programs.
The website also contains two important technical resources for schools:
- Video Streaming Series. DSA, in collaboration with CHPS, has produced a series of online videos
43
on high performance school construction, including such topics as site analysis, energy performance, water resources, daylighting, building materials, and indoor environmental quality.
- Environmentally Preferable Products Database. As required by SB 373, DSA is developing an Environmentally Preferable Products Database for Sustainable Buildings. The database will collect information on materials (e.g. recycled content, VOCs, and life cycle costs) for use in High Performance Schools and other state buildings. A supplementary grant provided by the US EPA's Pollution Prevention Program will allow the database to include several additional material categories for analysis.

Conferences Highlight Sustainable Building
- Conference on Building and Operating Sustainable College Campuses in the 21

st
Century. The UC Merced "Conference on Building and Operating Sustainable College Campuses in the 21
st
Century" took place in April 2003 with support from a U.S. Environmental Protection Agency grant and assistance from the SBTF.
44
The conference had three primary objectives: (1) to share plans, progress and experiences in building a sustainable UC Merced campus with college administrators and planners, (2) to inform participants about sustainable practices, and (3) to provide opportunities for participants to learn more about green activities occurring at other educational institutions in California and elsewhere. Over 150 participants from higher education, state government and the private sector attended the two-day event. Plans are already underway for a follow up Conference in June 2004.

- Housing Conference Offers Green Building Session. The 2002 annual Department of Housing and Community Development Affordable Housing Conference featured a green building track, developed with the help of the SBTF. The track focused on actual construction projects throughout the state, including Santa Monica's Colorado Court
45
and Emeryville's Resourceful Building Project.
46
Due to its success, a green building track will again be included in the 2003 conference, featuring green affordable housing success stories and available tools and incentives for state and local agencies, non-profits, and private developers.

Task Force Authors Sustainable Building Articles

- Environmental Goals and Policy Report. With the passage of AB 857
47
the Governor's Office of Planning and Research (OPR) was tasked with developing a revised Environmental Goals and Policy Report (EGPR). In order to develop a report that will accurately reflect the state's planning goals for the next 20-30 years, OPR convened a working group of state agencies to advise this process. The EGPR, scheduled for completion in Fall 2003, will develop the State's plan for sustainable development. The SBTF is providing comments and helping to establish goals and policy priorities for the final report.
- Building Better Buildings: Sustainable Building Activities in California Higher Education Systems. An article on the SBTF and its partnership with the University of California, California State University, and California Community College systems was featured in the Spring 2003 Edition of "Planning for Higher Education," the Journal of the Society for College and University Planning. This edition was a special issue focused on sustainability.
48
Many of the activities outlined in the article for future action by the SBTF and California's higher education systems have been accomplished or are currently ongoing, including adoption of the UC system wide Green Building Policy and Clean Energy Standard and coordination of the UC Merced conference on sustainable building in higher education institutions.
- American Council for an Energy-Efficient Economy (ACEEE) Summer Study. The SCSA published a paper in the ACEEE Summer Study 2003 proceedings, Sustainability and Industry: Increasing Energy Efficiency and

Reducing Emissions,
49
related to research on quantifying the costs and
benefits of green building.
• Greenbuild International Conference and Expo. Five abstracts submitted by SBTF members were accepted for inclusion in the US Green Building Council's 2003 International Conference and Trade Show
50
to be held in
November 2003. Topics include: costs and benefits of green building, managing the costs of LEED, Building Materials Emissions Testing Study, greening the modular furniture contract, and the diversion of construction and demolition waste in California.
• The Planning Report. The Planning Report is a monthly newsletter, which explores land use planning and managed growth issues in California. State and Consumer Services Agency Secretary, Aileen Adams, was interviewed for the September 2003 edition of The Planning Report, to discuss California state government's progress in the sustainable building arena.
51
This interview highlights leadership projects, particularly high performance schools and the new UC Merced campus, which will be the greenest campus in the nation.
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Agency Promotes Sustainable Building
One key to the successful implementation of any new initiative is executive support. The SCSA Secretary and Undersecretary have been keynote speakers at a number of sustainable building forums, including:
• Bren Hall Opening Ceremony at the Donald Bren School of Environmental Science & Management, UC Santa Barbara
• Dedication of the Education Headquarters Building, Block 225 of the Capitol Area East End Complex, Sacramento, CA
• Dedication of the Photovoltaic Array on the Roof of the Franchise Tax Board, Rancho Cordova, CA

- Kick-off Event for San Diego Chapter of USGBC – "LEEDing San Diego into a Sustainable Future", San Diego, CA
- Local Government Commission Building a Sustainable Infrastructure for the 21st Century Conference, Monterey, CA
- Testimony to the UC Board of Regents, Grounds and Buildings Committee, Oakland, CA
- UC Merced, Conference on Building and Operating Sustainable College Campuses in the 21st Century, opening remarks, Modesto, CA
- Sustainable Northwest Sustainability Forum, Portland, OR

IN DEPTH: High School Green Design Project Piloted

The Center for Advanced Research and Technology (CART) is a joint magnet school for high school juniors and seniors, administered by the Fresno and Clovis Unified School Districts. CART provides intensive educational opportunities in 13 lab areas for its students using a public/private partnership model. The architecture lab at CART traditionally engages students in 4 design projects during the course of the school year. As one of the few high school architecture programs in the state, CART provided an opportunity for the State and Consumer Services Agency, through its School Energy Efficiency (SEE) Program, to develop and implement an energy efficiency and green building curriculum.

The School Energy Efficiency Program, through a grant from the California Public Utilities Commission, provided funding to assist in the creation and implementation of a "green" design project. Students worked in teams to apply new green and energy efficient design concepts to a real design problem, a Boys and Girls Community Center, in the Fresno and Clovis communities.

The project relied on a multi-faceted learning approach, including lectures; small group collaboration; participation in a design charette;

oral and written reports; a design competition; and field trips to green buildings. The ultimate goal of the CART project is to tie the application of green building and energy efficiency to learning in the classroom. A teaching guide is in the process of being developed, complete with curriculum and lessons learned from the project. The SBTF and SEE Program staff hope to replicate this project in other high school architecture programs in the state.

Environmental Awards Program Now Recogniies Sustainable Facilities

For the first time in its ten-year history, the 2003 Governor's Environment and Economic Leadership Awards (GEELA),

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considered the most prestigious environmental award in the state, include a Sustainable Facilities category. The SBTF worked closely with the GEELA staff to initiate this new award category and is currently in the process of helping to evaluate applications. A total of fifteen submissions in the Sustainable Facilities category were received and awards will be presented in November 2003.

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IV SIGNIFICANT PARTNERSHIPS ESTABLISHED

The momentum around sustainable building is capturing the attention of California cities and counties, federal, state, and local governments, nonprofit organizations, and international bodies. An abundance of new laws, fiscal incentives, performance guidelines, building technologies, and construction projects focused on sustainable building pervade the national landscape. The Task Force has forged strong relationships with public, private, and non-profit sector entities inside and outside California that are working on green building issues. This section highlights California's many sustainable building collaborations and partnerships.

Institutions of Higher Education Adopt Green Policies and Practices

Over the next decade, California's higher education institutions will be involved in over $20 billion of new construction and building renovation – making higher education the most prolific builder in California during this time. Recognizing the impact that higher education systems will have on the construction industry, the SBTF has emphasized partnering with the University of California, California State University, and California Community College systems.

IN DEPTH: ENERGY STAR FOR DORMS PROGRAM

The SBTF is working with the federal Department of Energy to implement an Energy Star for dorm rooms project within each of California's systems of higher education. This program, modeled after a successful project at Tulane University,
1
will select dorm
rooms located on four campuses (at least one CSU, UC, and CCC campus) and outfit these rooms with energy star appliances. The SBTF program will also include the use of recycled content and/or low VOC materials.
2
Students will be involved in recording and
analyzing energy use, as well as promoting energy efficiency across the various systems.
2

University of California
The UC Board of Regents' Committee on Grounds and Buildings passed a resolution in December 2002 calling for a feasibility study to explore implementing a system-wide green building policy and clean energy standard. In response to this resolution, the UC Office of the President (UCOP) convened a Steering Committee comprised of design and energy experts, key state government officials (including the Secretary of the State and Consumer Services Agency), and campus fiscal and budget administrators to guide the study. In July 2003, the UC Regents passed a system-wide green building policy and clean energy standard for all future UC campus construction.

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The SBTF has also been working closely with the following UC campuses:
University of California, Merced
UC Merced will be the first major research university built in the 21st Century and the tenth UC campus. The UC Merced administration has already made a firm commitment to sustainability -- establishing a goal of achieving the LEED□ Silver rating for the entire campus. The State and Consumer Services Agency (SCSA) Secretary is the chair of the UC Merced Implementation Team (Red Team), and the SCSA has been involved in a number of building, land use, transportation, and housing issues related to the campus. UC Merced is also a pilot partner in the Labs for the 21st Century initiative co-sponsored by the United States Environmental Protection Agency and Department of Energy.
University of California, Santa Barbara
UCSB has established a tentative goal of LEED Silver for all new campus construction within the Facilities and Construction departments. It is the intention of the University to make this a campus-wide policy in the near future. To help implement this goal, UCSB has established a Central Campus Sustainability Committee (CCSC). This group meets monthly to coordinate campus goals and set policy.
The University and the State have initiated conversations with the US Green Building Council to determine the extent to which in-house commissioning (performed by UC Santa Barbara Facilities Managers or Building Property Management at the state level) will be accepted for the LEED commissioning prerequisite and additional commissioning (Energy and Atmosphere Credit 3).
54
Traditionally, the USGBC has required a third party "Commissioning Agent" which often translates into significant costs to the project. UCSB and the SBTF are interested in developing commissioning expertise in house and making it standard practice for all new and existing facilities.
Davis Langdon Adamson (DLA) is working with the Donald Bren School of Environmental Science and Management at UC Santa Barbara to complete a follow-up report on the costs of greening Bren Hall (currently

the only Platinum LEED 1.0 building in California). This report will develop
22
a better understanding of the actual cost of greening the Bren design, including construction costs, operations savings, environmental benefits, and the cost implications of designing Bren to LEED 2.1 and LEED Labs standards.
The cost implications of building LEED on the UC Santa Barbara campus are also being developed. DLA has met with the SBTF to present their findings and incorporate suggestions. Preliminary findings suggest that it is possible to build LEED 2.1 Certified on the UC Santa Barbara campus for added cost, that Silver adds between .5 and 1.5%, and that the cost for LEED Gold and Platinum can range anywhere from 1 to 15%.
California State University (CSU)
The California State University understands the strong correlation between environmentally friendly construction and occupant satisfaction, and is committed to implementing these principles in new and renovated facilities on its 23 campuses. The CSU system is committed to the design of new and renovated structures utilizing best practices to provide energy-efficient systems; lower life cycle costs for construction and equipment; and durable finishes in support of university academic programs. The CSU Committee for Development of Sustainable Design Policy will finalize the CSU policy for presentation to the Board of Trustees in January 2004. The policy will provide a consistent standard with a CSU-administered certification process to ensure that campuses consider available technologies for all construction projects. Sustainable design is considered part of a holistic design process, similar to the inclusion of accessibility, with no designation of additional funding.
Specific capital projects with strong sustainable components include the following:
CSU Chico
Chico State has taken strides to incorporate LEED standards on their new Student Services Building. This project will serve as a demonstration project for the implementation of this standard, and will likely be designed to the LEED Gold level. In recognition of state agency programs, and embracing holistic green design, Chico State held an official signing of the LEED application for this project in Sacramento in September 2003. Costs for this certification were provided for the project by non-state sources.
CSU Northridge

Northridge has completed a photovoltaic (PV) array in a surface parking area (Lot D6). This installation has an output of 225 kilowatts of direct current (DC) electricity, and provides shaded parking spaces. A second PV array in Lot B1, now under construction, will provide 467 kilowatts of DC power. The campus has also installed six micro-turbines fueled by natural gas, each generating 30 kilowatts of co-generated power.

23CSU Sonoma

The renovation of Salazar Hall, completed in Fall 2002, features a unique system of low-energy cooling, lighting control, and high-efficiency glazing, which results in energy usage 42 percent lower that what is required by the state's building standards. The building features an air circulation system that provides 100 percent fresh air to the facility at all times. In addition, a 1,200-module solar panel system on the roof of Salazar Hall will provide 96 kilowatts of direct-current electricity. The campus is planning at least two additional photovoltaic projects.

IN DEPTH: MOSS LANDING MARINE LABORATORY

Moss Landing Marine lab (MLML) is a 60,000 square foot, multi-purpose building built overlooking the Pacific Ocean at Moss Landing, California. The new MLML building replaced the old laboratory complex that was destroyed in the Loma Prieta Earthquake in 1989.

During 2002, MLML was chosen as one of 80 buildings in the USA to pilot the US Green Building Council's new program for Existing Buildings, LEED-EB. Although not originally designed as a 'green, sustainable' building, the LEED-EB process has shown that MLML stands out as an example of sustainable construction and operation.

Highlights include:

- Passively designed building with excellent vision glazing, operable windows and exterior shading.
- 21 acres of newly replanted native species, including species that were on the federal endangered list.
- Rainwater runoff directed to a newly constructed wetland and conservation areas.
- Use of only "Greenseal" products, eliminating zinc from the floor polishes and sealers, and further reducing the impact of

all cleaning products from the custodial operation.
• All paper hand towels contain at least 100% recycled content and 40% post-consumer content. They are also chlorine free.
MLML's submission paperwork for LEED-EB is nearly complete, and the building is currently on target for a Gold rating.
24

California Community Colleges
In an effort to assess the growing operational and maintenance needs of roughly 108 community college campuses, the Chancellor's Office contracted to conduct comprehensive facility condition life cycle assessments. Data from these assessments will be compiled, tracked and rolled into a systemwide online planning and management tool, known as Fusion. This Fusion program will be used to inform the CCC system about its facilities and enable policy-makers to make better decisions about future investments in new construction, renovation and retrofit projects. It is anticipated that this effort will result in improved facility planning, better maintained and operated buildings, and more sustainable capital outlay projects. The CCC has also developed a statewide energy management plan that includes alternative technologies, renewable energy, and sustainable construction strategies.
DeAnza Community College
De Anza College will begin construction on the Kirsch Center for Environmental Studies in December 2003. The Center will showcase energy efficiency, resource conservation, renewable energy technology, and will be one of the first outstanding of a sustainable building in the California Community College system. This 22,000 square foot classroom integrates east-west orientation for passive solar benefits and daylighting, uses an advanced natural ventilation system, incorporates recycled/nontoxic materials and paints, as well as on-site photovoltaic electrical generation, raised floor air distribution, and other energy innovations.
55

Los Angeles Community College District
In March 2002, the Board of Trustees of the Los Angeles Community College District (LACCD), the largest district in the state including 9 campuses and some 120,000 students, made a commitment that all future new construction projects funded by Proposition A monies would become LEED□ Certified. In addition, new LACCD buildings must obtain between 15 and 25 percent of their energy demand from renewable energy sources, including at least 10% from onsite generation, such as photovoltaics and wind power.
56
San Diego Community College District
In September 2003, the San Diego Community College District, the second largest district in the state, adopted LEED certification for new construction projects. The Board of Trustees made this commitment for $685 million in Proposition S construction projects.
25
Partnering With the Architecture and Building Code Community

The SBTF plans to expand partnership opportunities with the American Institute of Architects (AIA), the California Architects Board, and Building Code officials in the upcoming months.

- In 1989, the AIA established the Committee on the Environment
57
to
address the issue of sustainable design. The SBTF will coordinate education and outreach efforts with the AIA's California Council to provide continuing education credits for sustainable design courses developed through this partnership.
- The California Architect's Board,
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within the Department of Consumer
Affairs, is responsible for certifying architects in California. The SBTF has begun to discuss sustainable building design training with the Board and to explore the inclusion of sustainable design questions on the architect's board exam.
- Recently, the California Building and Standards Commission adopted a

new building code, the National Fire Protection Association (NFPA) 5000 building code, the NFPA Uniform Fire Code, and some provisions of the International Residential Code Council to serve as the basis for the next California Building Code and California Fire Code.
59
This code is still being revised for use in California, and the SBTF will work with code officials to incorporate sustainable building considerations into the final document.
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IN DEPTH: FEDERAL NETWORK FOR SUSTAINABILITY

The Federal Network for Sustainability (FNS) is a voluntary partnership among federal agencies on the West Coast of the United States (particularly California, Washington and Oregon) geared toward the promotion of sustainable environmental stewardship and the implementation of the President's "Greening Government" executive orders. The group was established in 2000 when 11 members signed a Statement of Unity on Earthday, detailing the core values of the Network, to develop and coordinate the Network; seek linkages and partnerships; create and manage an information sharing clearinghouse; develop and deliver training for network members; communicate ideas through conferences and meetings; and, be a catalyst for change.
To support these values and the promotion of sustainable environmental stewardship, FNS has adopted 5 initiatives with specific project goals and milestones:
1. Copier Paper
2. Environmental Management Systems
3. Green Power
4. Electronics Products Stewardship
5. Sustainable Buildings
The SBTF and FNS first began working together on green building

issues several years ago with a joint meeting to explore issues in common. Since that time, the SBTF has continued to coordinate with the FNS on several issues, including: US Department of Navy Projects, US Green Building Council chapter activities, and multi-state partnership opportunities developed through the Sustainable Northwest Sustainability Forum in Portland, OR.

Tas Force Generates New State Agency Wor ing Groups

Although the SBTF has been the primary forum for discussing sustainable building issues, Task Force activities have expanded and become so varied that participants recognized the need to form subgroups to address specific issues. The following sections describe the work of some of these subgroups:

2

Affordable Housing Working Group

This group works with the Department of Housing and Community Development and others interested in housing issues to promote green building practices among the developer community, establish a green building website, design and construct an affordable housing project, and expand bond program policies to encourage the greening of affordable housing projects.

Driving Green Task Force

Building siting decisions and building energy use have a tremendous effect on infrastructure requirements and transportation systems. Several factors prompted the organization of the Driving Green Task Force, including Executive Order D-46-01, the Renewable Portfolio Standard law,

60

and the state's climate change activities. The Driving Green Task Force (DGTF) complements the goals outlined in these initiatives by addressing issues related to fuel efficiency in the state fleet, energy independence, greenhouse gas emissions, environmentally friendly practices, telecommuting policies, vehicle procurement specifications, the alternative fuel infrastructure, and employee travel policies. The DGTF will also attempt to develop partnerships with other public and private entities engaged in vehicle use policy, using a $100,000 grant from the California Integrated Waste

Management Board.
Environmentally Preferable Purchasing Task Force
The work of this group was initially founded in the East End Green Team's efforts to create a green modular office furniture specification. Following the enactment of AB 498 (Chan),
61
which requires Department of General Services and the California Environmental Protection Agency to "provide state agencies with information and assistance regarding environmentally preferable purchasing", the Green Team became the "Environmentally Preferable Purchasing Task Force" (EPPTF). The EPPTF now meets every month to focus on green procurement issues involving purchasing policies and the development of environmentally friendly specifications for building materials and technologies.
Grant Awarded to Support Cooperative Purchasing of Carpet
The US Environmental Protection Agency recently awarded the EPPTF a $30,000 grant to draft a new state carpet specification and to develop a process for cooperative purchasing of environmentally preferable products. Developing an environmentally friendly carpet specification is an important undertaking for California as we recently added our name to the signatories of the Memorandum of Understanding for Carpet Stewardship. This MOU commits the State of California to a ten-year schedule to increase the amount of reuse and recycling of post-consumer carpet and to reduce the amount of waste carpet going to landfills. In this agreement, California joins with seven other states, the Federal Government, environmental organizations, and industry in tackling this significant waste management issue. This year, through the efforts of motivated private recycling businesses, California diversion of carpet has increased from negligible levels to approximately 20% (or approximately 40,000 tons).
28

State Develops Environmentally Preferable Purchasing Priorities
To address the issue of environmentally preferable purchasing, the SBTF worked with a nationally recognized expert, Green Seal, to develop:
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- A list of priority product/service categories based on purchasing volume, environmental impact, environmental improvement potential, policy/programmatic priorities, and contracting opportunities;
- A list of criteria to determine the environmental attributes of specific products and commodities; and
- Guidelines to address the environmental impacts of procurement processes by introducing life cycle costing, use and end-of-life management factors into specifications.

Environmentally Preferable Purchasing Website Launched

The California Integrated Waste Management Board, in collaboration with the Environmentally Preferable Purchasing Task Force, launched the EPP Website in Spring 2003.

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The website is intended to provide valuable tools and resources, case studies, and information on current state EPP projects.

Historic Preservation Working Group

There is a clear synergy between historic preservation and sustainable building -- reusing or preserving a building in most instances is more environmentally friendly than building new. Recently, the State Office of Historic Preservation and the Division of the State Architect have spearheaded an effort to integrate these two compatible areas into the work of the SBTF.

This working group is currently in the process of developing a green and historic webpage for the state's Green Building Website, drafting a greening of historic preservation brochure, and planning a series of "green building" sessions for the upcoming 2004 California Historic Preservation Conference. Additionally, the group is working to establish green criteria for the 2004 Governor's Historic Preservation Awards and identifying a historic preservation demonstration project for the SBTF to pursue.

Relocatables Working Group

Over 80,000 portable classrooms are currently located on California K-12 school campuses, and many of these units are over 20 years old and in various states of disrepair. Recent research conducted by the California Air Resources Board and the Department of Health Services indicates that the indoor environmental quality of these units need to be addressed. The Relocatables Working Group is charged with drafting improved specifications for new portable classrooms, and a white paper that identifies data collection needs and makes recommendations to

develop a retrofit program for existing portables and establish new operations and maintenance guidelines for new and existing facilities.
29

Integrated Pest Management Working Group
The project management team at Block 225 of the Capitol Area East End Complex has established a fairly aggressive integrated pest management approach using beneficial bugs and native plantings. IPM practices generally result in healthier landscapes at lower cost due to reduced use of pesticides, which greatly offset any increased costs of labor. However, few other state projects and landscaped areas currently utilize IPM practices to their full potential. The Task Force is interested in expanding IPM efforts at Capitol Park, in direct response to Assembly Bill 2472 (Simitian).
64
To address this issue, an IPM Working Group was established by the SBTF to draw upon the expertise of the East End Team, the California Integrated Waste Management Board, the California Department of Pesticide Regulation, and the San Francisco Department of the Environment. San Francisco has established a comprehensive IPM program in Golden Gate Park, which, like Capitol Park, exhibits a wide variety of flora and fauna. The IPM group has started to develop a plan, which will include the training of state property management staff and ultimately the designation of an IPM point person.
Complementary Wor□ing Groups Support SBTF Activities
In addition to the above subgroups, SBTF members are also very active with several other interagency task forces, programs, and working groups that are complementary to the SBTF efforts.
California Commissioning Collaborative
The California Commissioning Collaborative
65
is developing a protocol to track
and assess the costs and benefits of whole building commissioning, which will be applied to a series of selected demonstration projects. The testing protocol will specify data collection points, data collection methods, project reporting formats, and a cost/benefit analysis mechanism for new and existing facilities. A

minimum of four case studies (including both new construction and existing facilities) will be included in the demonstration program. Once case studies are complete the collaborative will compile results and deliver commissioning trainings statewide.
Fuel Cell Collaborative
The California Stationary Fuel Cell Collaborative
66
is comprised of a core group
of state agencies, including the Air Resources Board, the California Energy Commission, and the Department of General Services, in addition to the National Fuel Cell Research Center. The mission of the Collaborative is to promote the commercialization of stationary fuel cells in California. Fuel cells help to:
30

- Reduce or eliminate air pollutants and greenhouse gas emissions;
- Increase energy efficiency and promote energy reliability; and
- Promote energy diversity, energy independence, and secure a sustainable energy future.

To address these needs and vulnerabilities, the Collaborative has committed to increasing the generation of power from renewable resources from the current level of 12 percent to 20 percent by the year 2010. The Fuel Cell Collaborative has set an initial goal of installing 50 to 250 megawatts of capacity by 2006 in California.
The Public Interest Energy Research (PIER) Program
The Public Interest Energy Research (PIER) Program
67
awards up to $62 million
annually for energy efficiency research and development in six program areas including “Residential and Non-Residential Buildings End-Use Energy Efficiency.” Reports this past year cover issues related to relocatable classrooms and building commissioning, among many others.
68
Over the next few months, the
SBTF plans to seek PIER funding to expand its green building research efforts.
Energy Policy Advisory Committee

The Energy Policy Advisory Committee (EPAC) is the oldest active energy conservation task force in California state government, initially authorized through Executive Orders in the 1980's. EPAC is made up of the energy conservation program managers from the ten largest energy consuming state institutions and departments. EPAC meets on a quarterly basis to review the current and future condition of the energy industry to determine how best to optimize energy use at state facilities

Joint Agency Climate Team

Convened by the Resources Agency, this group is working to coordinate state efforts to mitigate the impacts of global climate change. The passage of AB 1493

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brought the issue of climate change and greenhouse gas emissions to the forefront of many state agendas. To date a series of 10 initiatives have been developed by JACT members and will be used to determine future efforts in this area. Task Force members helped to craft an initiative on building energy efficiency and associated impacts of global climate change.

Recycled Water Task Force

The Recycled Water Task Force

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was created by Governor Davis' signing of AB 331 (Goldberg)

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in October 2001. The State Department of Water Resources, in conjunction with the State Water Resources Control Board and the Department of Health Services, administers the Task Force. The Task Force, in collaboration with many other experts, developed recommendations to increase the use of recycled water. The study found that there is a potential to increase the amount of recycled water use in California from the current level of approximately 500,000 acre-feet to about two million acre-feet annually by 2030. This will free up an amount of freshwater equivalent to 30 to 50 percent of the domestic water

3

needs of the 17 million new Californians expected by 2030.
The Recycled Water Task Force identified and adopted 26 issues with respective recommendations to address obstacles, impediments, and opportunities for California to increase its recycled water usage. Recommendations associated with thirteen of these issues were adopted as key recommendations deserving of more immediate attention. The SBTF plans to pilot some of the report's building and technology recommendations into future state construction projects.
IN DEPTH: SUSTAINABLE PARKS PROGRAM
In 2002, the Department of Parks and Recreation established a Sustainable Design Task Force with the goal of integrating sustainability into the development and operations of state parks. To implement the goals of the Task Force, the department issued a Design Directive to its Service Centers which stated, in part, that sustainable design features needed to be included in all building designs and specifications, where possible. Several State Park facilities are already incorporating sustainable design as delineated by the Task Force and Design Directive:
• Tule Elk Preserve: incorporates a $35,000 photovoltaic system to pump water for wildlife at the reserve
• Picacho: 4 Clivus Multrum composting toilets were installed to replace existing chemical toilets resulting in significant savings and reduced maintenance requirements.
• Angel Island: Onsite run-off will be recycled and utilized for irrigation.
• Cardiff State Beach: Seaside Day Use Area has a solar roof where the panels are the roof, not attached to it.
• Hearst Castle, San Luis Obispo Coast District: a demonstration project showcases photovoltaic, fuel cell, microturbine, wind and hydro technologies to supply primary power and to offset peak power requirements.
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V RECOGNIZING LEADERSHIP
Recognizing leadership, excellence, and innovation in the area of sustainable building is an important way to educate the community at large about the green

design and construction. The Task Force is working to integrate sustainable building practices into specific projects. This section describes the awards program and highlights ten leadership building projects.

The Capitol Area East End Comple)T2

As discussed earlier, this $392 million, five building, 1.5 million square foot complex is the largest state government office building project in California's history. The complex consolidates the majority of the Departments of Health Services and Education from various locations around Sacramento, housing more than 6,000 state employees.

The Capitol Area East End Complex "greening" process started roughly four years ago with the decision to incorporate sustainable building practices into the project's design and construction documents. To facilitate this process, the Secretary of the State and Consumer Services Agency convened representatives from the California Integrated Waste Management Board, California Energy Commission, Department of Health Services, and California Air Resources Board to assist the Department of General Services and Department of Finance in reaching consensus on this groundbreaking effort. This inaugural "green building" effort marked the beginning of the Sustainable Building Task Force.

Some of the complex's most significant sustainable building features include:

- Energy efficiency measures enable the complex to exceed the 1998 Title 24 standards by 30%, saving an estimated $500,000 in annual energy costs.
- The modular furniture meets new environmental specifications that are considered the most "sustainable" in the world and was ultimately less expensive than the standard product.
- The strongest indoor air quality strategies ever used by DGS were integrated very early into construction process, and included extensive building material testing and a thorough building flush out.
- Materials were selected for high recycled content and low pollutant emissions, including carpet with 53% recycled content and acoustical ceiling tiles with 82% recycled content.

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- The first DGS-installed under floor air distribution system in the Block 225 building allows individual temperature control to enhance employee productivity and comfort.
- 5,000 photovoltaic panels produce up to160 kilowatts of electricity on-site.
- "Cool roofing" material reflects sunlight and reduces cooling costs up to 40%.
- More than 30,000 square feet of salvaged marble flooring from the historic Library and Courts Building was incorporated into the main lobbies of all five buildings.
- 97% of construction waste -- more than a quarter of a million tons – was diverted from landfill disposal. Ten 60-foot historic California fan palm trees were removed and re-planted in Capitol Park.
- "Smart" light controls, high-efficiency indirect fluorescent lighting, window glazing, and open workstations optimize natural light penetration.
- Interior and exterior water efficiency measures include low-flow plumbing fixtures and plant-segregated irrigation systems.
- Electric vehicle charging stations, preferred carpool and alternative fuel vehicle parking, and bicycle lockers and shower facilities promote clean air.
- Rubberized Asphalt Concrete (RAC), which incorporates crumb rubber from recycled tires into the asphalt mixture, was used to pave the roadways around the complex. The RAC diverted 11,000 tires, equating to 66 tons (132,000 pounds) of waste tires, from the landfill.

Through the incorporation of these and many other sustainable building features, the Department of Education Building was able to achieve a United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED□) Gold rating, making it the most sustainable building ever built in state government history. The four remaining East End Buildings are expected to achieve LEED Silver.

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University of California, Santa Barbara, Donald Bren School of Environmental Science ♦ ManagementT♦

Bren Hall is an 84,672 square foot, $22 million building on the UCSB campus that

houses the Donald Bren School of Environmental Sciences and Management. The building contains a laboratory wing, central courtyard, faculty and staff offices, as well as classrooms and conference rooms. Bren Hall opened in May 2002 and is one of the "greenest" buildings in the United States, achieving a Platinum rating under the US Green Building Council's Leadership in Energy and Environmental Design (LEED) program -- one of only two buildings in the country to receive such an honor. Some of the building's sustainable features include:

- Operable windows that interlock with the heating system; motion/heat/ambient light sensors; an efficient boiler; a chiller that is connected to the campus loop; and a cool roof combine to enable the building to surpass 1998 Title 24 requirements by 31 percent.
- Building orientation maximizes the potential for daylighting and takes advantage of natural cooling from outside air (the office wing has no air conditioning system and relies on ocean breezes for cooling).
- A variable air volume (VAV) fume hood system in the lab wing with control systems corrects for pressure changes in the labs, reduces laboratory energy use, and maintains high levels of indoor air quality.
- Reclaimed water utilized for landscape irrigation and waterless urinal technology is employed throughout the building, resulting in savings of 160,000 gallons of water annually.
- On-site energy generation from rooftop photovoltaic panels supplies roughly 10 percent of the building's energy needs. A total of thirty percent of the building's energy is supplied by renewable sources, purchased from recovered landfill waste gas.
- Over 90 percent of construction and demolition debris was recycled.
- High percentages of recycled content materials comprise the exterior envelope and interior finishes including: structural steel, concrete, carpet, rubber flooring, ceiling tiles, and insulation. For example, restroom countertops are 80 percent post-consumer content recycled glass and restroom partitions are 90 percent recycled content plastic.

Bren Hall has become the model green building within the UC system, and will serve as a prototype for the design of the UC Merced campus, which is scheduled to open in fall of 2004.

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Caltrans District ◆ HeadquartersT4
Construction of this 716,200 square foot, $190 million project began in April 2002, with completion anticipated in late 2004. This project is one of the first state facilities to participate in the Excellence in Public Buildings program, which outlines eight priority areas, including architectural excellence, sustainability and energy efficiency, integration of public art, cost-effectiveness, safety and security, customer satisfaction, accessibility, and community input.
Some of the more unique sustainable features incorporated into the project include:

- A 13-story, full building height atrium provides natural daylight to the interior core of building, ensuring that as many occupants as possible can enjoy the benefits of improved indoor environmental quality.
- High performance glazing, occupancy sensors, daylight dimmers, high efficiency chillers, and other HVAC system components work together to conserve energy and reduce utility bills. In addition, workers will have the ability to control light levels at their desks, improving efficiency and occupant control.
- Photovoltaic panels will provide approximately 95 kW of clean, renewable energy.
- Over 90% of construction & demolition waste will be diverted from landfill disposal through material recycling and salvage.
- An innovative exterior Scrim Panel rotates to optimize shading based on the sun's orientation, letting daylight in, but keeping solar heat out.
- Modular furniture, initially developed for use at the Capitol Area East End Complex, is considered the most sustainable in the world.
- A Building Automation System allows for central control and greater system efficiency.

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Franchise Ta) Board Butterfield Way State Office Building

Comple)

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Located in Sacramento, the Franchise Tax Board's Butterfield Way State Office Building Complex includes 850,000 square feet of renovations of two existing buildings and 1,000,000 square feet of new office, warehouse and central plant space. The existing Building 2 incorporates over an acre (50,000 square feet) of photovoltaic panels that supply nearly a half a megawatt (470 kWp), generating enough electricity to power more than 400 homes in the Sacramento area. This is the largest single rooftop array on a state building. In addition, the project has been designed to accept additional photovoltaic systems and thermal energy storage as funding becomes available.

This $211 million project is expected to be complete in August 2005. Although not originally targeted to use LEED, the design team has now established a goal of achieving the LEED Certified level. Sustainable components of this renovation and new construction project include:

- Natural bio-swales are incorporated in the parking lot to control water quality in storm water runoff.
- The project is expected to exceed Title 24 energy efficiency standards by more than 20 percent through the incorporation of fixed sunscreens at all east, west and south facing windows, low-e glass, a central heating and cooling plant with energy management system and variable frequency drives, smart lighting controls, and an energy star rated roof.
- Alternative transportation is encouraged through the incorporation of 300 bicycle lockers, shower and change facilities; extensive pedestrian walkways; and preferred parking for car/vanpools.
- The new facility is sited within one hundred feet of a Light Rail Park and Ride Station, helping to reduce the number of single occupancy trips to and from the site.
- A 75 percent recycling and diversion goal has been established for construction and demolition waste recycling. The reuse of demolished

asphalt and concrete as sub-base in the parking lot areas, as well as ground up greenwaste as mulch resulted in the diversion of approximately 20,000 tons of material from the landfill.

- Existing oak and walnut trees and shrubs that were not preserved were chipped and used as landscaping mulch.
- Materials were selected with consideration for low volatile organic compounds (VOCs), recycled content, and other environmentally friendly qualities such as ease of cleaning, maintenance, ability to be recycled, and life cycle cost.

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Science Center School
76
The Science Center School, located in Exposition Park, will be an affiliated charter school within the Los Angeles Unified School District. Its Center For Science Learning will operate under the jurisdiction of the California Science Center, a state museum that has over 1.3 million visitors a year. Together these two institutions will serve as a professional development school and a model for how to integrate the school facility into the surrounding community. The governance structure for the school will be an ongoing partnership between the Science Center and the School District to ensure its development as a neighborhood school with a thematic emphasis on mathematics, science, and technology. The Center for Science Learning will provide professional development in science, math, and technology for other educators. The school is scheduled to open in the late spring or early summer 2004.
The school itself is a dramatic example of the synergies between historic preservation and sustainability.

- The historic Armory Building is being reused according to historic preservation requirements. This results in a significant diversion of construction and demolition debris from the landfill.
- Shielding the school is a shrubbery berm that faces Exposition Boulevard. This berm replaces more traditional landscaping, will require minimal upkeep,

and is drought resistant. It will also absorb particulate matter from street traffic.

- The school will have a sod roof consisting of a juniper type shrub, which will soon develop a dense and extensive rooting system. The sod roof is drought resistant, requires minimal maintenance, and should help to stabilize interior temperatures – keeping the building cool in the heat and holding heat during the cool months.
- An unconditioned atrium in the Armory will save energy and a science garden will add a greening effect.
- All existing Armory windows will be resealed for improved insulation, and a building automation system installed for maximum energy effectiveness.
- Recycled materials and products, such as paint and carpets, will be utilized whenever practical.

38

CalPERS Headquarters E)pansion Project

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The California Public Employees' Retirement System (CalPERS) is a public pension fund providing retirement and health benefits to state and local public employees. Its new headquarters expansion (550,000 gross square feet and 450,000 square feet of underground parking) will cover two full downtown Sacramento blocks with two U-shaped office buildings of 4 and 6 stories each. The project features a sculptured glass atrium, a layered pattern of shading devices on the clear glass and aluminum facade, a trellis-covered veranda, a raised floor air distribution system, and several outdoor terraces. The project contains some first-floor retail space as well as an underground vehicle and pedestrian concourse connecting the existing Lincoln Plaza Building to the new buildings. Anticipated completion is Spring 2005.

CalPERS is a LEED™ registered project and is aiming for a LEED Silver certification. From the very beginning of the project, CalPERS demonstrated a

commitment to using sustainable design principles:

- Early in the process, the entire team participated in a green building workshop to prioritize the green strategies for the project.
- The project will incorporate a 73kW array of photovoltaic panels providing 5% of the building's energy.
- Energy savings should exceed the Title 24 code requirements by 25%, and metering will measure, monitor, and verify the efficiency of the building systems.
- Underground parking is provided (for almost 1,000 parking spaces) to reduce the urban heat island effect and to lessen the development footprint.
- Green materials will include bamboo flooring, recycled-content and regionally manufactured materials, and FSC-certified wood doors and work surfaces.
- More than 75% of construction waste will be recycled.
- The project will implement almost all of the LEED Indoor Environmental Quality strategies, including low-emitting materials, daylighting and views, construction IAQ management, thermal comfort, and increased ventilation effectiveness.

39

La�eview Terrace Library

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Construction of the 10,700 square foot, $4.3 million, 68th Branch of the Los Angeles Public Library system and its Environmental Awareness Resource Center was completed in January 2003. This project, considered by some to be the most environmentally friendly building in Los Angeles, was envisioned as a sustainable building demonstration project. As such, the project is a model of energy and water efficiency, use of recycled content materials, and drought tolerant landscaping. The

project, which received a grant from the California Integrated Waste Management Board, will submit for LEED certification at the Gold or Platinum level in late 2003. Significant sustainable building features include:

- A cooling tower that circulates internal air through cool water, windows with sensors to respond to heat and humidity, and a trellis structure on the west-facing entry plaza combine to reduce heat absorption and the need for air conditioning on hot summer days.
- Skylight designs in concert with exterior shading devices and smart lighting controls combine to produce enhanced interior lighting and energy efficiency levels forty percent better than those found in traditional libraries.
- Photovoltaic panels generate help to offset the energy demand of this facility.
- A number of recycled content and rapidly renewable interior finish materials were included in the project, including bamboo flooring and recycled content carpet, walls, panels and tiles.
- Permeable pavement in parking areas and stormwater retention ponds reduce runoff and promote on-site infiltration and irrigation.

This building exemplifies sustainable systems and will serve as a model for green library construction throughout the state.
40

Camp Arroyo Environmental Education Center
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Located in Livermore, California, Camp Arroyo is a residential youth camp facility designed to serve up to 200 children. This environmental education camp serves middle school students, as well as critically ill children and other guests. The facility was designed to demonstrate state-of-the-art sustainable design principles, and incorporates these and other ecological principles into the camp's environmental education curriculum.
Construction of Camp Arroyo began in September 1999, supported in part by a grant from the CIWMB. The energy efficient design includes the use of solar energy for water and space heating; durable, resource efficient and recycled-content building materials including straw bale, stabilized earth, sustainably harvested wood, recycled plastic toilet partitions, recycled glass tiles and countertops, recycled newspaper insulation, and wheat straw wall paneling; water conservation measures and on-site alternative wastewater treatment.

The Camp Arroyo Environmental Education Center was recognized by the American Institute of Architects (AIA) Committee on the Environment as one of the Top Ten Green Projects for 2002.
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CHPS Demonstration School: Cahuenga Elementary School
81
Cahuenga Elementary School is a 55,000 square foot campus in Los Angeles Unified School District with enrollment of over 800 students. School construction is targeted to commence in September 2003. Cahuenga Elementary will be the first facility in LAUSD to use the Collaborative for High Performance Schools (CHPS) guidelines and criteria. It is anticipated to achieve 48 (out of a possible 81) CHPS points, making it one of the greenest schools in the state. As mentioned previously, LAUSD adopted CHPS criteria as the system-wide standard for new school construction projects.
Significant high performance and sustainable features include:
- High solar reflectivity surfaces, ample landscaping, and shading strategies minimize urban heat island effect (and therefore reduce air conditioning needs)
- Exterior occupancy sensors turn off lights when not in use, and design features limit light pollution.
- A combination of daylighting, smart lighting controls, and high efficiency HVAC systems allow the school to exceed Title 24 energy efficiency code requirements by 35%.
- Porous surfaces, such as open grid pavement, promote groundwater infiltration and minimize runoff.
- Natural bioswales capture and treat storm water runoff on site.
- Carefully selected materials, a tight building envelope, and a quiet HVAC system promote optimal acoustic performance and quality of learning in classrooms.
- Climate appropriate landscaping and efficient irrigation techniques significantly reduce exterior water use.

- High efficiency plumbing features are used in all indoor applications to reduce water use.
- Ceiling tiles, wall panels, paint, insulation, and concrete have high-recycled content and low emissivity.
- Over 75% of construction waste will be diverted from the landfill.
- Design and construction site management measures prohibit dust and microbial growth.

42

CalEPA Headquarters Building

(leased space)

The California Environmental Protection Agency Headquarters stands 25 stories tall, covers 950,000 square feet, and is home to 6 boards, departments, and offices, including the Office of the Secretary. The building is a model of environmentally friendly operations and maintenance practices and is the first state project to participate in the USGBC's Leadership in Energy and Environmental Design for Existing Buildings (LEED-EB) Pilot Program, anticipating a Platinum rating. Some of the building's sustainable features include:

- The facility was designed and is operated with optimal air quality, energy efficiency, recycling, and resource efficiency in mind. 42 policies and structural elements protect the integrity of these priorities.
- High levels of energy efficiency enable the building to be identified as an Energy Star facility. The structure scored 96 of 100 points for two years in a row – making it the most efficient high-rise structure in the Nation.
- In cooperation with SMUD, Cal/EPA purchases 100% Greenergy – promoting the development of green power generation.
- Air quality is of highest priority, and established policies control everything from the type of carpet used, to the type and timing of the use of construction and cleaning products, to the ban of leaf blowers and pesticides. Employees and visitors are also encouraged to avoid wearing fragrances while in the building.
- Aggressive recycling programs allowed for the recycling of over tons of materials in 2002, and the use of over 120,000 worms in the composting

program “ate” 10 tons of organic garbage. Compost made is used in the landscaping on the grounds. Major structural elements must be recycled and recyclable, and may not be sent to landfill. That includes furniture, carpet, and ceiling tiles, among other items.

- Eight waterless urinals are installed in the facility, as part of a pilot testing program, and will save up to 320,000 gallons of water per year.
- Siting considerations and significant transportation incentives and programs have resulted in 65% of the Cal/EPA employees’ using alternative transportation modes such as public transit, car/vanpooling, cycling, and teleworking.
- Cal/EPA maintains an agency-wide Environmental Management System, which continuously measures outcome of environmental efforts, and provides new goals and timetables for new accomplishments. Cal/EPA has also established a 20% CO
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reduction goal, over 2000 levels, by the year 2010.

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VI GOALS FOR 2003 - 2005

In its December 2001 report, Building Better Buildings: A Blueprint for Sustainable State Facilities, the Sustainable Building Task Force set out a ten-point action plan to implement the Governor’s sustainable building goals, as established in Executive Orders D-16-00 and D-46-01. As detailed throughout this document, many of these implementation milestones have been met, exceeded, are significantly underway. The road to sustainability, however, must be marked with signs that consistently show progress. With this principle in mind, the Task Force established the following goals as next in its series of sustainable building milestones.

1. Environmental Leadership Performance Standard. Establish the performance goal of obtaining a cost effective LEED Silver level (or higher) for appropriate state projects such as offices and other institutional buildings. Use LEED as a design guide for other less applicable state projects, including warehouses and parking structures. For projects unable to meet the LEED

silver level without additional upfront cost, establish a procedure for life cycle cost analysis of additional green building features and systems necessary to reach this standard. Components that achieve payback during the life of the system should be included in design.
Supplement LEED as appropriate with other standards including California Special Environmental Requirements Section 01350. Advocate that school construction projects use the Collaborative for High Performance Schools (CHPS) criteria.
2. Economics and Financing. Finalize the economic analysis report, The Costs and Financial Benefits of Green Building, and update processes and decision-making to support financing of sustainable building projects.
3. Project Implementation Process Changes. Incorporate sustainable building and life cycle costing language in policy and administrative documents that define project scopes:
• Establish green building and energy efficiency requirements as standard practice in the State Administrative Manual (SAM).
• Make changes to the standard DGS Protocol for project implementation to reflect energy efficiency and green building as initial project goals. Bidding documents including specifications and qualifications should reflect this change.
• Ensure through changes to A&E documents that experienced sustainable building professionals are part of the design and construction team.
4. Legislation. Seek to codify sustainable building policies and programs implemented through the executive order into statute. Pursue opportunities to make sustainable building language standard in infrastructure, construction, bond and related legislative measures.
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5. Renewable Energy. Analyze and make recommendations to establish renewable energy and green power standards for state projects. Use the Renewable Portfolio Standard, which establishes a requirement for state purchase of 20% of energy from renewable sources by 2017, as a guide and take advantage of incentive programs.
6. Commissioning. Integrate "total building" commissioning
83
and facility
performance evaluations as standard Department of General Services policy for all new construction, infrastructure, and rehabilitation projects. Designate a "plant manager" from Building Property Management at time of initial design concept discussions to follow project implementation, including ultimate responsibility for building operations and maintenance.
Develop commissioning guidelines for new K-12 school facilities, and integrate them into the state funding and permitting process. For other smaller and/or less applicable projects, pursue abbreviated forms of commissioning, including sampling.
7. Operations and Maintenance. Identify, define, and adopt building operation and maintenance performance guidelines for state facilities focusing on resource efficiency, extending the useful life of facilities, and incorporating environmentally friendly practices. Review LEED for Existing Buildings (LEEDEB) and its application for incorporation into Department of General Services
building performance guidelines. Work with the Department of Finance to include a state infrastructure operations and maintenance element in the next budget letter to ensure adequate state resources are available to protect state infrastructure assets, and provide long term savings.
8. Measuring Performance. Develop a series of economic, social, and environmental performance indicators, including data collected from commissioning and facility performance evaluations. Develop a building performance feedback loop to improve existing and future buildings. Assist other infrastructure areas, specifically K-12 school districts, in measuring the performance of their facilities.
9. Outreach and Training. Update and continue to improve outreach, education,

training, and on-line resources, especially in these priority infrastructure areas: schools, historic preservation, DGS facilities, and affordable housing. Expand sustainable building collaborations, in particular, research activities with public, private, and non-profit sector entities.

10. Leadership and Partnership Opportunities. Expand SBTF involvement in public and private leadership projects and pursue funding opportunities to support these projects. Develop demonstration projects for priority infrastructure areas, including renovation and/or rehabilitation projects, affordable housing and residential construction, historic buildings and properties, lease buildings, libraries, veteran homes, educational facilities, laboratories, modular and relocatable structures, hospitals, and museums.

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VII CONCLUSION: TWO YEARS IN REVIEW

California's sustainable building programs, initiatives, and accomplishments over the last two years position the state as one of the national leaders in this area. Two Executive Orders, issued by Governor Davis, establish the state's green building goals and guide the state's implementation strategy, which is anchored in environmental stewardship and fiscal responsibility. This report, Building Better Buildings: An Update on State Sustainable Building Activities, details the commitment of the Sustainable Building Task Force and its public, private, and non-profit affiliates to design and construct leadership buildings, develop innovative programs, expand partnership opportunities, and conduct pioneering research. Clearly, significant policy considerations and program issues still lie ahead on California's road to sustainability; however, the Sustainable Building Task Force remains steadfastly committed to improving the state's building process one step at a time, ever mindful of John Muir's observation that:

"WHEN ONE TUGS AT A SINGLE THING IN NATURE, (S)HE FINDS IT ATTACHED TO THE REST OF THE WORLD."

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Appendi) A: Sustainable Building Tas Force Members

STATE AGENCIES

Business, Transportation and Housing Agency http://www.bth.ca.gov/
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Department of Transportation http://www.dot.ca.gov/hq/oppd/rescons/rchomepg.htm
California Environmental Protection Agency http://www.calepa.ca.gov/
Air Resources Board http://www.arb.ca.gov/
Department of Pesticide Regulation http://www.cdpr.ca.gov/
Department of Toxic Substances Control http://www.dtsc.ca.gov/
Integrated Waste Mgt Board http://www.ciwmb.ca.gov/greenbuilding
Office of Environmental Health Hazard Assessment http://www.oehha.org/home.html
State Water Resources Control Board http://www.swrcb.ca.gov/
Department of Finance http://www.dof.ca.gov/
Health and Human Services Agency http://www.hhsdc.ca.gov/
Department of Health Services http://www.cal-iaq.org/
Office of Planning and Research http://www.opr.ca.gov/
Office of the State Librarian http://www.library.ca.gov/
Resources Agency http://resources.ca.gov/
California Energy Commission http://www.energy.ca.gov/
Department of Forestry and Fire Protection http://www.fire.ca.gov/php/index.php
Department of Parks and Recreation http://www.parks.ca.gov/
Department of Water Resources http://www.dwr.water.ca.gov/
Office of Historic Preservation http://www.ohp.parks.ca.gov/
State and Consumer Services Agency http://www.scsa.ca.gov/
California Science Center http://www.casciencectr.org/
California Public Employees Retirement System http://www.calpers.ca.gov/
Dept of General Services http://www.dgs.ca.gov/default.htm
California Power Authority http://www.capowerauthority.ca.gov/default.htm
Division of the State Architect http://www.dsa.dgs.ca.gov/default.htm
Energy Management Division http://www.emd.dgs.ca.gov/default.htm
Real Estate Services Division http://www.resd.dgs.ca.gov/default.htm
Procurement Division http://www.pd.dgs.ca.gov/default.htm
Franchise Tax Board http://www.ftb.ca.gov/
State Treasurer's Office http://www.treasurer.ca.gov/
Youth and Adult Correctional Agency http://www.yaca.state.ca.us/
California Youth Authority http://www.cya.ca.gov/

Department of Corrections http://www.cdc.state.ca.us/
Prison Industry Authority http://www.yaca.state.ca.us/
INSTITUTIONS OF HIGHER EDUCATION
California Community Colleges http://www.cccco.edu/
De Anza College http://www.deanza.fhda.edu/
Foundation for California Community Colleges http://www.foundationccc.org/
California State University http://www.calstate.edu/CPDC/
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INSTITUTIONS OF HIGHER EDUCATION
Humboldt State University http://www.humboldt.edu/
University of California http://www.ucop.edu/
UC Berkeley http://www.berkeley.edu/
UC Merced http://www.ucmerced.edu/
UC Office of the President http://www.ucop.edu/
UC Santa Barbara http://www.ucsb.edu/
California Institute for Energy Efficiency http://ciee.ucop.edu/
LOCAL GOVERNMENTS
City of Los Angeles
http://www.ci.la.ca.us/ead/EADWeb-MWR/Sust/sustainable_building.htm
City of San Diego
http://www.ci.san-diego.ca.us/environmental-services/ridgehaven.shtml
City of San Francisco http://www.ci.sf.ca.us/sfenvironment/aboutus/greenbldg/
City of San Jose http://www.ci.san-jose.ca.us/esd/GB-HOME.HTM
STATE GOVERNMENT
State of Washington-Governor's Office http://www.governor.wa.gov/
FEDERAL GOVERNMENT
Department of the Navy http://www.navfac.navy.mil/
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Total Building Commissioning (TBC) is defined by the National Institute of Building Sciences as

the systematic process of ensuring that the performance of the facility and its systems meet the

design intent and the owner/occupant functional and operational needs. TBC should: 1)

effectively document the design intent; 2) identify and perform tests that show that the whole

building and its systems meet the owner's functional requirements; and 3) provide a

comprehensive and appropriate basis for training building operations and maintenance

personnel. TBC guidelines should address all major building systems

It's true: Green buildings do boost sales, rental and occupancy rates

Posted by: Adam Aston on April 03, 2008

Call it green magic. According a pair of studies that offer the first broad-scope examination of the economics of green buildings, they really do it all: lower operating costs, boost rental rates, increase sales values and even improve occupancy rates.

I've been skeptical. As much ink — or e-ink — has been spilled repeating the virtues of green buildings, there's been woefully little hard data on how high-tech, high-efficiency buildings actually help the bottom line. "Trust us," the green building industry seemed to be saying in recent years: "Build green and you will see rewards." Such claims are instinctively believable, of course, because it makes sense that using less energy should lower building costs and make them more attractive both to tenants and future owners. Less rationally, green buildings embody the promise that very advanced technology can help solve our climate problems.

But the data has been scant, till now, because the vast bulk of green buildings are just a few years old, so data on their resale value, rental rates, and occupancy has been statistically slim. The results are in, and all those green building developers have reason to crow. A pair of studies released this week — one by the New Buildings Institute (NBI) and one by CoStar Group— support the claims. Amidst softening real estate markets, the news will be especially welcome. The data suggest that developers who abide by green standards put out by the US Green Building Council or the EPA's Energy Star program will be able to fill their buildings fuller, and rent and sell them for more money than a conventional structure. The industry's next great challenge: to deliver similar metrics for the improvement of existing buildings, where the great bulk of the nation's energy is used, and wasted.

GREEN PREMIUM

Here's how two building standards programs cut the energy use and enhance the finances of newly built green commercial buildings

	Energy savings	Rent premium, per sq. ft.	Increase in occupancy rates	Sales premium, per sq. ft.
LEED certified	25-30%*	$11.24	3.8%	$171

Energy star certified	<40%	$2.38	3.6%	$61

* 25-30% for all LEED buildings, including certified, silver, gold and platinum grades. For gold and platinum, the savings approach 50%.

Methodology: Using CoStar's commercial property database of roughly 44 billion square feet, the study analyzed over 1,300 LEED Certified and ENERGY STAR buildings that totaled about 351 million sq ft. These were compared with non-green properties with similar size, location, class, tenancy and year-built characteristics to generate the results.

The NBI study was funded by USGBC with support from the U.S. Environmental Protection Agency and can be accessed here:

https://www.usgbc.org/ShowFile.aspx?DocumentID=3930

View more information on the CoStar Group study:

http://www.costar.com/News/Article.aspx?id=D968F1E0DCF73712B03A099E0E99C679

http://www.scribd.com/doc/87 28499/Green-Buildings-and-Bottom-Line-2006-White-Paper

Sustainability

At this early stage, Stanford is committed to achieving or exceeding a rating comparable to the LEED Silver rating. Examples include preserving green space through the choice of building site, using environmentally friendly materials in the construction of the building (see table below), and driving better efficiency in the mechanical systems to save 2.5 million kWh per year (the equivalent of 375 California homes). In addition, Stanford has set a goal of a 20% reduction on the pertinent mechanical standards for this building (20% of ASHRAE 90.1).

- Install a highly-efficient energy management system that will reduce energy consumption of a typical research building by approximately 25%
- Improve freezer management by replacing old freezers, purchasing only energy-saver units, and allowing a certain fixed number of freezers in the building
- Capitalize on natural light by installing a state-of-the-art light management system that adjusts light levels as the day progresses, thus reducing electricity use
- Reuse and/or reclaim water by installing low-flush toilet fixtures that will be serviced by water from reclaimed sources
- Protect, preserve or eliminate the use of water by designing thoughtful landscaping -with any water used being drawn from a gravity-fed bio-swale system located on campus

Sustainability Building Elements

Water/Site

- Low flow/waterless plumbing fixtures throughout
- Process water efficiently
- Gray water system making use of wastewater from an adjacent facility
- Storm water from roofs treated for water quality via vegetated swales (rather than via

mechanical/constructed means)

- Onsite storm water infiltration (rather than sent into the strom sewer)
- Secure bicycle parking and shower/changing facilities to encourage alternative transportation

Energy/Systems

- Optimized shading design to reduce solar heat gain
- Window systems and ceilings designed to admit daylight and offset use of electric lighting
- White, Energy Star compliant roofing to reflect heat from the sun, thus lowering cooling demand and mitigating the urban heat island effect

Material Impacts

The design team is proposing to use both recycled content, rapidly renewable resources and lox VOC interior materials throughout the facility. Examples of the proposed materials include:

- Carpet with recycled content nylon
- Bio-based composition tile and/or recycled content floor tile, in lieu of traditional VCT
- Recycled content terrazzo tile
- No VOC, latex paint
- Bamboo veneer for lab casework and interior doors with MDF core; no urea formaldehyde additives
- FSC certified wood products where bamboo is not specified
- PVC free shade cloth at window coverings
- Materials that meet the 500 mile radius LEED requirement

Indoor Air Quality

- Wind tunnel testing of building model to minimize re-entrainment of exhaust air
- Operable windows, where practical, offset cooling and allow a diret connection with the

outdoors

Mechanical Systems

- 20% target energy reduction based on 2005 California Energy Efficiency Standards – Title 24
- Portable measurement provisions for monitoring individual lab equipment power consumption
- Measurement and optimization systems for building energy and water consumption
- Process water efficiency
- System commissioning
- No CFCs or HCFCs
- Indoor ventilation rates per ASHRAE 62
- Construction and pre-occupancy Indoor Air Quality Management Plan
- Low VOC content materials
- Thermal comfort compliance with ASHRAE 55
- Controllability of systems
- Permanent monitoring system
- Provide monitoring and control of fume hoods and room pressure
- Indoor environmental safety – fume hood commissioning, alarms
- Increased building wall and roof insulation
- Best available glazing systems: 0.25 to .029 Shading Coefficient
- Variable volume laboratory air handling systems

- Low velocity filter banks 400 ft per minute or less
- Low pressure supply air handling systems
- Low duct air velocities – 1500 ft per min maximum with a target of 0.06" to 0.1 range pressure drop per 100ft of duct
- Seal all duct systems and leak test (all or spot-check) ducts
- Variable speed pumping for Chilled Water systems
- Variable speed pumping for Heating Hot Water system
- Reverse-return piping
- Premium efficiency motors
- Use of limited combination sash fume hoods
- Un-occupied hours setback space air change rates
- Un-occupied hours setback temperatures
- Chilled water temperature reset
- Heating hot water temperature reset
- Supply air temperature reset based on critical zone
- Supply and exhaust duct static pressure optimization based on critical zone
- Domestic and industrial hot water circulator scheduling for occupied hours of operation
- Heat Recovery at exhaust system
- Space lighting control scheduling

Electrical Systems

- 20% target lighting energy reduction based on 2005 California Energy Efficiency Stds –

title 24

- Right-size laboratory electrical distribution panels and transformers by utilizing data obtained from comparable laboratory space
- Permanent or portable measurement provisions for monitoring individual laboratory equipment power consumption
- Measurement and optimization for building energy

California Energy Efficiency Standards – Title 24

The design goal is to exceed standards by at least 20%; will attain through:

- T8 or T5 lighting at approximately 1.0 watts/SF
- Photo sensors for daylight harvesting
- Occupancy sensors
- Optimum lamp/ballast combinations
- Highly reflective surfaces for light fixture housings similar to “MIRO Micro Matt”
- High efficiency transformers

Plumbing Systems

- Reduce potable water usage inside the building. Low-flow fixtures are used and waterless urinals are under consideration
- Eliminate process water usage inside the building
- Reclaim water for toilet flushing

The campus and the design team are fully committed to meeting their respective sustainability goals. In addition to these programs, the School of Medicine plans to manage and operate the building in a manner that reduces waste, recycles materials and reuses material where possible.

We are committed to building and operating the Lorry I. Lokey Stem Cell Research Building in an environmentally friendly manner to minimize effects on the environment.

Make a Gift

Plumbing Engineering

by Winston Huff, CPD, LEED AP

Smith Seckman and Reid Engineers, American Society of Plumbing Engineers (ASPE)

Last updated: 07-22-2010

Within This Page

Introduction

The earth has a complex natural biospheric recycling system that converts air, water, and solid waste of animals through plants, soil, and evaporation to fresh water and air for animal consumption. Successful societies respect the biospheric systems by reproducing the earth's recycling systems in their own artificial biospheric plumbing system. Historically, as societies grew in complexity and size, so did the plumbing systems supporting them. A disciplined method of water hydrology grew as evidenced in the Roman aqueduct system. Through the centuries these valuable methods were lost. In the past few centuries, with the growth of the industrial revolution and the scientific method, new plumbing methods were formalized into different engineering professions. The Plumbing Engineer is involved with systems that overlap into the mechanical, civil, and chemical engineering disciplines. The Plumbing Engineer is in a key position to influence the water efficiency, sustainable site, energy, fire protection, and pollution systems of a facility. The future of Plumbing Engineering lies in the ability to design systems with the "whole building" in mind using, preserving, and respecting the natural biospheric earth systems of recycling air, waste, and water.

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Description

Plumbing Engineering responsibilities overlap into the professional engineering areas of Civil Engineering, Mechanical Engineering, Chemical Engineering, Fire Protection Engineering, and Process Engineering. Traditionally the Plumbing Engineer performs the calculations, sizes the equipment, and prepares the plumbing design and construction documents under the supervision of a licensed Mechanical, Fire Protection or Civil, Professional Engineer.

In most states the Mechanical Engineer supervises the Plumbing Engineers' responsibilities in the following areas: (61G15, Florida Administrative Code)

- Design of Process and Fluid Flow Systems
- Design of Plumbing Systems
- Design of Heat and Energy Transfer Systems

The Plumbing Engineer supports the Civil Engineer for the plumbing systems outside the building including storm water, sewer, natural gas, fire suppression water, domestic water, irrigation water, and other special water and waste systems.

The Plumbing Engineer plays a different role in the design of the Fire Suppression sprinkler systems for a facility. The whole building approach to the design of the building is very important when incorporating fire protection requirements into a facility. The design professionals, including the Plumbing Engineer, will rely on the recommendations of the Fire Protection Engineer. The Fire Protection Engineer will develop building hazard classifications coordinating with the different fire protection requirements for a facility. The Plumbing Engineer will work in concert with the Fire Protection Engineer when fire protection systems requiring water is required. For example, in some buildings the Fire Protection Engineer can highlight options where the building can be designed in a way it will not require automatic water based sprinkler systems without compromising building safety. In these cases the Fire Protection Engineer can inform the design team using the whole building approach that the building is more efficient and will cost less to the owner including a water-based automatic sprinkler system into the building design.

In these cases including automatic water-based sprinkler systems will reduce the amount of materials and construction required in a building and as a result reduces the cost of the building and meets one of the qualifications for a sustainable building. This close collaboration using the whole building approach is a benefit when the design, construction, and maintenance teams of a facility apply for permits and certifications, because they have a coordinated fire protection plan for the facility.

The plumbing engineer is involved in the whole building design of a water-based fire suppression system. In a typical facility the city water main will supply water for the fire suppression system. The plumbing engineer will need to coordinate with the civil engineer, water department, and fire department the details of connecting the fire water to the city water main.

Fire hydrants, valves, alarms, and fire department connections are designed for the site. When the water main enters the building there is alarm and backflow devices designed by the plumbing engineer. In larger building standpipes are installed usually in exit stairs with fire department connections for fire department personnel to connect hoses and suppress the fire in the building during a fire event.

Automatic sprinkler systems are connected to the building standpipes that will supply water to the sprinkler heads distributed throughout the building. In taller building fire pumps are required to boost the city water pressure and flow to the fire department connections and sprinkler systems. The plumbing engineer plays a key role to include water demands for a sprinkler system with the water demands for a plumbing system.

Sports facilities are a good example of highlighting the importance of coordination. During a football game fans were standing in line using the toilet facilities, creating a large demand from the city water system. At this same time a grill left burning in the parking lot during a tail gate party started a small fire. When the fire department arrived there was not enough water pressure in the fire hydrants to supply water to their hoses to extinguish the fire. In these cases, it is important to have a plumbing engineer looking at the plumbing design of the whole building.

When the design professionals, including the plumbing engineer, have developed the basic parameters of water based fire suppression systems for a building the hydraulic calculations for the fire suppression system begin. In some states the plumbing engineer prepares preliminary calculations as described by NFPA 13. In other states the licensed fire protection contractor is responsible for these calculations. In either case the plumbing engineer will review and comment on these calculations before the system is installed.

When preparing facility contract documents for building construction the Plumbing engineers are involved in the Construction Specification Institute MasterFormat 2004 Specification sections:

- Division 21 Fire Suppression
- Division 22 Plumbing
- Division 33 Utilities
- Division 43 Process Gas and Liquid Handling, Purification and Storage Equipment

These responsibilities differ with the type and size of a project and the individual organizational structures at a particular Engineering firm. In general, these responsibilities remain the same.

As the design of the building utilizes more sustainable systems the responsibilities of the Plumbing Engineer can interact with specialists and designers of some of these systems. For example, if a green vegetative roof is appropriate for a facility, during the conceptual stage of a project a green roof design specialist is added to the design team. The design and detailing of the green roof system must be carefully coordinated between several professionals: the Architect for roof membrane design and drain locations, the Plumbing Engineer for roof drainage fixtures and piping, the green roof specialist, and the Structural Engineer for roof loading impacts of the green roof.

Because of the broad scope of responsibilities and areas of overlap with other design professionals, it is important to have the Plumbing Engineer on the project team as early as possible. The Plumbing Engineer can provide input in the following areas:

- **Domestic/Potable Water System**—This is the water provided by a municipal or site-sourced water system. The Plumbing Engineer designs the water distribution system to protect the public health to the plumbing fixtures, landscaping irrigation, fire suppression system, filtration systems, mechanical systems, cleaning systems and process equipment. A complex building requires special treated water systems and manufacturing facilities require special process water systems. The Plumbing Engineer can develop the design of these systems while keeping in mind that the ultimate whole building goal is to reduce the amount of water used by a facility. For example a storm water collection system can be used in the landscaping irrigation system in stead of an irrigation system using domestic water. Using this whole building approach the domestic water usage is reduced.

- **Domestic Hot Water**—Domestic water arrives at the building the same temperature as the ground. There are requirements for hot water in a facility usually for washing or bathing. The Plumbing Engineer designs the water heating equipment and the distribution system for the hot water piping so hot water is available at a reasonable amount of time to the plumbing fixtures. The Plumbing Engineer can design low energy consumption water heaters, hot water recirculation systems to reduce the amount of domestic water wasted down the drain when users are waiting for hot water to reach the fixture. They can also design hot water systems using alternative fuels such as bio-diesel or energy generated on site from items such as windmills and solar water heaters.
- **Plumbing Fixtures**—The Plumbing Engineer coordinates the appropriate type of fixtures in the different areas of the building. Close coordination is required for code requirements, number and placement of the plumbing fixtures. Looking at the domestic water system and sewer system with the whole building approach the Plumbing Engineer realizes that low flow fixtures reduce water and sewer consumption. In a municipal system, reducing the amount of municipal sewer and domestic water taken from and placed into the local fresh water supply, depends on more buildings using a water conservation approach to water supply and disposal.
- **Sanitary Sewer Systems**—Water flowing from plumbing fixtures collects in the building sewer system. The Plumbing Engineer designs this system to a point it connects to a municipal sewer system or to an on-site disposal or containment system. Some facilities require a separation between waste streams and/or treatment of special waste systems before they enter a common building waste system. For example, the grease waste from a kitchen can damage the sewer piping system. As a result, a grease trap is installed to capture the grease before it enters the common building system.
- **Storm Water Systems**—During a rain or storm event rain water falls on building roofs, parking lots, and green spaces. In northern climates snow or ice falls on a site in the same places. The water from the rain or snow is collected in the storm water system. The question of what to do with this water is becoming a debated topic and requires different approaches in different locations. The traditional way to manage storm water was to remove it from the building and site as quickly as possible. In some growing communities this approach resulted in devastating results by creating flooding and contaminating fresh water supplies downstream of the buildings. Options on methods to handle storm water should be discussed early in the design process.

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Emerging Issues

Members of the plumbing industry are beginning to look at the plumbing systems of the whole building as it relates to the other design disciplines, owners, installers, operators, users, and the community outside the building. For example, the whole building approach looks at the storm water that fell upon a site as a resource and when possible retain the storm water on site. Systems are now available and are required in some areas that maintain the amount of storm water run off from a site to match the predevelopment natural amount of run off from the site. As a result, the whole building approach to site design and storm water management can exceed regulatory run off requirements, reduce potable water usage, reduce sewer flow and reduce storm water flow from a site.

Because of this trend the Plumbing Engineer can present design options that can retain the water on the roof with restricted flow roof drains or green vegetative roofs. Or, water reuse systems can be designed to collect the water and reuse the water for irrigation, building process water systems, or toilet flushing systems. The Plumbing Engineer can also develop concepts to design pipe distribution systems that can return this water in the ground on the site in green areas or under parking lots. Early involvement of the Plumbing Engineer in the whole building design process is necessary to integrate water conservation design options with the work of other design professionals.

Because of water efficiency concerns water free urinals are becoming a popular fixture. Many of the major plumbing manufacturers are now making these products. Because these fixtures are different they require a different approach by the facility maintenance team. They are installed and maintained differently than traditional units and reduce water consumption. A whole building approach is needed with use of these fixtures to include representatives of the owner, contractor, maintenance and housekeeping staff, and the user. When all the parties are aware of the special requirements the fixtures can operate successfully for years.

Water-free toilets are composting fixtures that require a small room next to the toilets for the composting equipment. There is a growing number of building owners that coordinate these fixtures with the landscaping crew to use the compost on the facility landscape features. The end result is a reduction of potable water to a facility and sewer waste from a facility.

Low-flow showers provide a comfortable shower while using less water and creating less sewer flow. Valve manufactures are making mixing valves that do not scald the users with hot water at these low flows when building water pressure changes. The designs of the shower heads are reworked to produce an even flow of water for a shower. Multiple head shower systems provide the user with large amounts of water for an upscale shower experience. It is important to realize the affect of these systems to other building systems such as room finishes, room exhaust, and hot water system. For a detailed discussion of moisture in the building environment, see WBDG Resouce Page Mold and Moisture Dynamics. Poorly designed systems can waste large amounts of water and energy when large amounts of hot water go down the drain. There are recirculation systems similar to whirlpool baths that re-circulate the shower water and can use less water and energy.

Green vegetative roofs reduce the amount of rain water run off from a site. These systems have growing media and plants growing on the roof. The plants use the water from rain, insulate the roof, and reduce the heat island effect of a building. They can provide an aesthetic element and reduce the size of site storm water retention systems.

Water reuse systems retain storm water in storage tanks for future use in other areas of the building or site. The water for these systems can be used for irrigation, process water, and for the plumbing toilets and urinals. These systems reduce the amount of storm water from a building and reduce the amount of potable water used in a building. They can add to the architectural elements of a building.

Specialty waste water separators that separate grease, fuel, acid and other hazardous materials from water streams help reduce fresh water pollution. Close coordination between regulatory agencies, design team, construction team, and building operations is required to have a properly operating system.

Water heating systems are traditionally fueled by gas or electricity. A new generation of solar systems is available to offset the cost of water heating. Heat recovery systems that capture the heat from drains from equipment such as clothes washing or HVAC condenser water systems can raise the incoming water temperature to the water heater. As a result, the amount of energy needed to heat water is reduced.

As societies develop and grow in size and complexity they realize the value of clean water and air as produced in the earth's natural biospheric systems. As a result, the society realizes the importance of plumbing systems that respect and replicate these natural biospheric systems.

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Relevant Codes and Standards

- American Gas Association (AGA)
- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- ASTM International Standards Worldwide
- Code Check-Help with Building Codes
- CSA International
- DOE Building Standards & Guidelines Program
- Environmental Protection Agency (EPA) for federal regulations concerning water quality, sewage, and storm water management
- ICC Evaluation Service
- International Association of Plumbing & Mechanical Officials (IAPMO)
- International Code Council (ICC)
- International Conference of Building Officials (ICBO)
- International Organization for Standardization (ISO)
- National Conference of States on Building Codes & Standards (NCS BCS)
- National Fire Protection Association (NFPA)
- NSF International
- Occupational Safety and Health Administration (OSHA)
- Underwriters Laboratories (UL)

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Major Resources

General Government Information

- ADA-ABA Accessibility Guidelines for Buildings and Facilities, 2004
- Department of Energy (DOE)
- Environmental Protection Agency (EPA)
- EPA—Information on Lead
- General Printing Office

- General Services Administration Public Buildings Service (GSA PBS)
- National Institute for Occupational Safety & Health (NIOSH)
- National Institute of Standards & Technology (NIST)
- Occupational Safety and Health Administration (OSHA)

Industry Associations

- American Backflow Prevention Association (ABPA)
- American Gas Association (AGA)
- American Hardware Manufacturers Association (AHMA)
- American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- American Society of Plumbing Engineers (ASPE)
- American Society of Sanitary Engineering (ASSE)
- American Supply Association (ASA)
- American Water Works Association (AWWA)
- Association of Home Appliance Manufacturers (AHAM)
- Association of Independent Manufacturers Representatives (AIM/R)
- Canadian Institute of Plumbing & Heating (CIPH)
- Copper Development Association (CDA)
- Mechanical Contractors Association of America (MCAA)
- National Association of Home Builders (NAHB)
- National Association of Manufacturers (NAM)
- National Fire Protection Association (NFPA)
- National Kitchen & Bath Association (NKBA)
- National Safety Council (NSC)
- Plumbing & Drainage Institute (PDI)
- Plumbing Heating Cooling Contractors-National Association (PHCC-NA)
- Porcelain Enamel Institute (PEI)
- Water Quality Association (WQA)

Industry Publications

- AWWA Journal
- Ceramic Industry
- Contractor
- Drinking Water & Backflow Prevention Magazine
- Plumbing Engineer
- Plumbing Systems and Design
- P&M Magazine
- PM Engineer
- Reeves Journal
- Supply House Times Magazine
- The Wholesaler

Other Websites of Interest

- Build.com
- PlumbingLinks.Com
- PlumbingNet.com (links to manufacturers)
- The Plumbing Warehouse

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By Paul L. Ham, P.E., LEED® AP

Here's a review of what a plumbing engineer/designer needs to know to successfully implement and promote a sustainable plumbing design.

Issue: 7/05

As our industry changes and grows with the 21st century, it is the responsibility of every member of a design and construction team to embrace and promote new technologies, methodologies, and most of all, paradigms. A paradigm is defined by Webster's dictionary as "a philosophical and theoretical framework of any kind." One such philosophical framework that is quickly gaining momentum in this industry is sustainable design.

Sustainability in our industry can be defined as the design, construction and ongoing operation of environmentally responsible, healthy and efficient building. As the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is currently one of the more popular frameworks by which sustainability is measured, this article will focus specifically on what LEED® plumbing-related credits and requirements are needed to implement and promote a sustainable design.

The plumbing designer is involved in up to 10 points within the 69-point LEED Building Rating System. This translates to roughly 15% of the possible points, while a building's plumbing systems typically cost 2-3% of the overall construction cost. As can be seen by these figures, the USGBC has placed a great deal of importance on plumbing within sustainable design.

Overview

The most important aspect of sustainability that the plumbing designer must understand is the concept of integration. Because plumbing design decisions can have both positive and negative impact on non-plumbing aspects of the overall design it is imperative that the plumbing designer be an active member of the team as early in the process as possible. Initially this will assist the plumbing designer in understanding and embracing the project's initial sustainable goals and objectives. Equally important, this early involvement will promote effective communication with all members of the design and construction team.

The overall intent of integrated sustainable design is to work as a team to maximize the interdisciplinary benefits of early design decisions and to realize synergies between disciplines that are not normally achieved through a traditional design approach.

Water Efficiency (WE)

One of the primary objectives of the plumbing designer is to determine how water will be delivered to, used and removed from a facility. Minimizing the consumption and maximizing the reuse of this resource is one key element of sustainable design.

Water Efficient Landscaping (LEED WE Credit 1.1 and 1.2)

Creatively minimizing the use of potable water or other natural surface or subsurface water resources for landscape irrigation can be done many ways—the most effective of which is to eliminate landscape irrigation altogether. If landscape irrigation is required, the plumbing designer should be involved in the overall design of the system to the greatest extent possible.

Although the landscape design is typically performed by a landscape architect, it is imperative that both designers work together to evaluate requirements, understand resources, and develop a landscape irrigation plan that minimizes the consumption of water. This plan may include one or more of the following strategies:

- Captured rain
- Recycled wastewater
- Other public agency treated and conveyed non-potable water sources

Implementing any of these options will require the involvement of the plumbing designer. In any case, the plumbing designer should be able to assist the team in making informed decisions related to these technologies. Understanding the local water resources, landscape, weather conditions, and owner's requirements are critical to effectively implementing this sustainable design strategy.

Innovative Wastewater Technologies (LEED WE Credit 2)

The traditional building plumbing design relies upon large volumes of potable water for the conveyance and removal of waste from a building, contributing to an overall reduction in the local water supply. An effective sustainable design focuses on reducing the generation of wastewater within a facility while increasing the local aquifer recharge.

This sustainable strategy can be implemented by either minimizing the use of water for waste conveyance or by treating wastewater within the facility, rather than allowing the waste to flow to the local water treatment facility.

The use of low-flow or no-flow plumbing fixtures within a facility is one method of reducing the quantity of water used for waste conveyance. Although low-flow fixtures are quickly becoming commonplace within the industry, building owners are still somewhat hesitant about the concept of no-flow fixtures, such as waterless urinals. The plumbing designer must understand the various alternative fixture technologies available and be able to present the pros, cons, costs and benefits that each fixture will provide.

Implementing an alternative means of sewage conveyance or on-site water treatment is another method of meeting this sustainable design strategy. The reuse of storm water or grey water can significantly reduce the consumption of potable water for sewage conveyance. Again, the plumbing designer is responsible for understanding the available technologies and leading the design and construction team through the cost/benefit analysis, design, installation and successful operation of these alternative systems.

Building Water Use Reduction (LEED WE Credit 3.1 and 3.2)

Maximizing water efficiency within a facility can be accomplished on two fronts: through the design and installation of high-efficiency water consuming devices, and through education of the building occupants. Although the plumbing designer has more control over the installed plumbing devices, it is important for the designer to be a strong advocate for educating building occupants about the importance of water conservation.

This credit within LEED is relatively easy to achieve through the use of high-efficiency fixtures, occupancy sensors, storm water reuse, grey water, etc. Two LEED points can be obtained through the design of a system that reduces water consumption by 30%. An additional point can be obtained under the innovation and design credit if a 40% reduction is realized.

Energy and Atmosphere (EA)

The plumbing designer is charged with designing systems that both conserve energy and promote a healthy atmosphere. There are several ways a plumbing designer can implement these systems.

Commissioning (LEED EA Prerequisite 1 and Credit 3)

Building systems commissioning is a process that is becoming highly valued by building owners, even outside the realm of sustainable design. This concept is used to verify that building systems are designed and installed in accordance with the owner's intent, and that the owner is sufficiently trained on how to effectively operate and maintain each commissioned system.

The sustainable plumbing designer is responsible for supporting the commissioning process through the development of a Design Intent Document (DID)—a document that quantifiably defines how each plumbing system is intended to operate and perform. For example, if a domestic hot water system is designed to produce water at 140˚F and then mix with domestic cold water to distribute at 120˚F, this information should be discussed with the owner early in the design process and included in the DID.

LEED Version 2.1 does not specifically require that plumbing systems be included in the systems being commissioned; however, the upcoming Version 2.2 (fall 2005) may require the domestic hot water system be commissioned. Plumbing designers must understand the commissioning process and how to effectively interface with its requirements.

Refrigerant Selection (Fire Suppression Systems) (LEED EA Credit 4)

Plumbing designers are responsible for the initial design of a building's fire suppression system. Facilities with unique fire suppression requirements are typically installed with systems that contribute to the depletion of ozone within our atmosphere, such as halon. A successful sustainable fire protection design should reduce ozone depletion through the design of a system that does not contain ozone-depleting substances, such as CFCs, HFCs, HCFCs or halons. This is a proposed addition to LEED that is being considered for Version 2.2.

Measurement and Verification (LEED EA Credit 5)

An owner's ability to continuously monitor and understand a facility's energy consumption will significantly increase their ability to optimize the consumption of energy within the facility. The sustainable plumbing designer should work with the owner early in the design process to identify the plumbing systems that the owner would like to monitor, and to design sufficient devices to monitor the performance of each system. This could apply to numerous plumbing systems, such as domestic hot water, pure water, compressed air, medical gas, liquid nitrogen, generator fuel systems, etc.

It is the responsibility of the plumbing designer to address this issue with the owner and the design team to evaluate the need for measurement and verification of building plumbing systems.

Materials and Resources (MR)

The plumbing designer is involved in the design and selection of multiple pieces of equipment and materials, each of which have an impact on the overall sustainability of a project. Although LEED contains two materials credits related to plumbing, divisions 13-16 do not contribute to the team's ability to achieve these points. Regardless, a sustainable plumbing designer should make every effort to design in accordance with the intent of these credits.

Recycled Content (LEED MR Credit 4.1 and 4.2)

The intent of this sustainable strategy is to increase demand for building products that incorporate recycled content. This is a strategy that the plumbing designer can support by understanding the availability of recycled materials within the plumbing industry. One of the obvious recycled materials used in plumbing systems is copper piping. Sustainability challenges plumbing designers to go beyond the obvious and specify recycled materials that may be less common.

For example, although most plastic waste piping is manufactured using virgin materials (due to strength requirements), there are manufacturers that produce waste piping with a recycled inner lining. A sustainable plumbing designer will include these requirements in the project specifications and not rely on the contractor to find a recycled component during the construction phase. The "D" in LEED represents "Design"—designers need to provide contractors with the information they need to effectively implement the sustainable design.

Regional Materials (LEED MR Credit 5.1 and 5.2)

Another sustainable strategy is to require the purchase and installation of building products that are regionally manufactured and/or harvested. This supports the use of indigenous resources and reduces the environmental impacts resulting from transportation.

The successful sustainable plumbing designer should understand the materials available within the geographical region of the project, and specify materials and equipment that are harvested and manufactured within a certain radius of the project site (LEED currently requires 500 miles).

For example, if the project site is in Waynesville, MO, and the designer's standard specification includes three domestic hot water pump manufacturers, only one of which is within 500 miles, the specification could be modified to only include the regional manufacturer, or equivalent if within the 500-mile requirement.

Indoor Environmental Quality (EQ)

The intent of this sustainable topic is to improve the indoor environment to increase productivity, decrease absenteeism and promote a healthy workplace. The plumbing designer can assist by specifying certain plumbing construction methods.

Low Emitting Materials (LEED EQ Credit 4.1)

The intent of this credit is to reduce the quantity of indoor air contaminants within a facility. Plumbing systems typically include piping systems that require field fabrication and/or joining. A sustainable plumbing design will specify the installation of systems that minimize or eliminate the need for traditional

construction methods such as welding, brazing, soldering, gluing, etc. Each of these traditional methods results in the off-gassing of odorous and potentially irritating Volatile Organic Compounds (VOCs).

A sustainable plumbing engineer will evaluate the feasibility of using alternative methods of joining materials, such as mechanical joints (Pro-Press, Victaulic, etc.). These should be included in the project specifications in an effort to assist the contractors in correctly bidding the project.

Summary

Sustainable design is a framework, or "paradigm," that is becoming increasingly popular within our industry—it is the responsibility of the designer to embrace and promote the design, construction and ongoing operation of environmentally responsible, healthy and efficient buildings. And don't forget, the plumbing designer can bring an additional LEED point to the project if they are a LEED-accredited professional.

Sustainable architecture

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Sustainable portable classroom design proposal

Sustainable architecture is a general term that describes environmentally conscious design techniques in the field of architecture. Sustainable architecture is framed by the larger discussion of sustainability and the pressing economic and political issues of our world.

In the broad context, sustainable architecture seeks to minimize the negative environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space. The idea of sustainability, or ecological design, is to ensure that our actions and decisions today do not inhibit the opportunities of future generations.[1] The term can be used to describe an energy and ecologically conscious approach to the design of the built environment.[2]

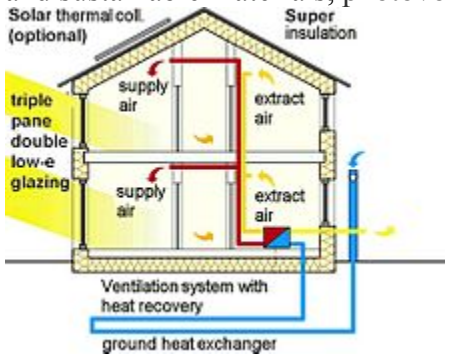
Contents

[hide]

[edit] Sustainable energy use

Main articles: Low-energy house and Zero-energy building

K2 sustainable apartments in Windsor, Victoria, Australia by Hansen Yuncken (2006) features passive solar design, recycled and sustainable materials, photovoltaic cells, wastewater treatment, rainwater collection and solar hot water.



The passivhaus standard combines a variety of techniques and technologies to achieve ultra-low energy use.

Following its destruction by a tornado in 2007, the town of Greensburg, Kansas (USA) elected to rebuild to highly stringent LEED Platinum environmental standards. Shown is the town's new art center, which integrates its own solar panels and wind generators for energy self-sufficiency.

Energy efficiency over the entire life cycle of a building is the single most important goal of sustainable architecture. Architects use many different techniques to reduce the energy needs of buildings and increase their ability to capture or generate their own energy.

[edit] Heating, ventilation and cooling system efficiency

The most important and cost effective element of an efficient heating, ventilating, and air conditioning (HVAC) system is a well insulated building. A more efficient building requires less heat generating or dissipating power, but may require more ventilation capacity to expel polluted indoor air.

Significant amounts of energy are flushed out of buildings in the water, air and compost streams. Off the shelf, on-site energy recycling technologies can effectively recapture energy from waste hot water and stale air and transfer that energy into incoming fresh cold water or fresh air. Recapture of energy for uses other than gardening from compost leaving buildings requires centralized anaerobic digesters.

HVAC systems are powered by motors. Copper, versus other metal conductors, helps to improve the electrical energy efficiencies of motors, thereby enhancing the sustainability of electrical building components. *(for main article, see: Copper in energy efficient motors)*.

Site and building orientation have some major effects on a building's HVAC efficiency.

Passive solar building design allows buildings to harness the energy of the sun efficiently without the use of any active solar mechanisms such as photovoltaic cells or solar hot water panels. Typically passive solar building designs incorporate materials with high thermal mass that retain heat effectively and strong insulation that works to prevent heat escape. Low energy designs also requires the use of solar shading, by means of awnings, blinds or shutters, to relieve the solar heat gain in summer and to reduce the need for artificial cooling. In addition, low energy buildings typically have a very low surface area to volume ratio to minimize heat loss. This means that sprawling multi-winged building designs (often thought to look more "organic") are often avoided in favor of more centralized structures. Traditional cold climate buildings such as American colonial saltbox designs provide a good historical model for centralized heat efficiency in a small scale building.

Windows are placed to maximize the input of heat-creating light while minimizing the loss of heat through glass, a poor insulator. In the northern hemisphere this usually involves installing a large number of south-facing windows to collect direct sun and severely restricting the number of north-facing windows. Certain window types, such as double or triple glazed insulated windows with gas filled spaces and low emissivity (low-E) coatings, provide much better insulation than single-pane glass windows. Preventing excess solar gain by means of solar shading devices in the summer months is important to reduce cooling needs. Deciduous trees are often planted in front of windows to block excessive sun in summer with their leaves but allow light through in winter when their leaves fall off. Louvers or light shelves are installed to allow the sunlight in during the winter (when the sun is lower in the sky) and keep it out in the summer (when the sun is high in the sky). Coniferous or evergreen plants are often planted to the north of buildings to shield against cold north winds.

In colder climates, heating systems are a primary focus for sustainable architecture because they are typically one of the largest single energy drains in buildings.

In warmer climates where cooling is a primary concern, passive solar designs can also be very effective. Masonry building materials with high thermal mass are very valuable for retaining the cool temperatures of night throughout the day. In addition builders often opt for sprawling single story structures in order to maximize surface area and heat loss.[*citation needed*] Buildings are often designed to capture and channel existing winds, particularly the especially cool winds coming from nearby bodies of water. Many of these valuable strategies are employed in some way by the traditional architecture of warm regions, such as south-western mission buildings.

In climates with four seasons, an integrated energy system will increase in efficiency: when the building is well insulated, when it is sited to work with the forces of nature, when heat is recaptured (to be used immediately or stored), when the heat plant relying on fossil fuels or electricity is greater than 100% efficient, and when renewable energy is utilized.

[edit] Renewable energy generation

[edit] Solar panels

Main article: Solar PV

Active solar devices such as photovoltaic solar panels help to provide sustainable electricity for any use. Electrical output of a solar panel is dependent on orientation, efficiency, latitude, and climate—solar gain varies even at the same latitude. Typical efficiencies for commercially available PV panels range from 4% to 28%. The low efficiency of certain photovoltaic panels can significantly affect the payback period of their installation.[3] This low efficiency does not mean that solar panels are not a viable energy alternative. In Germany for example, Solar Panels are commonly installed in residential home construction.[4]

Roofs are often angled toward the sun to allow photovoltaic panels to collect at maximum efficiency. In the northern hemisphere, a true-south facing orientation maximizes yield for solar panels. If true-south is not possible, solar panels can produce adequate energy if aligned within 30° of south. However, at higher latitudes, winter energy yield will be significantly reduced for non-south orientation.

To maximize efficiency in winter, the collector can be angled above horizontal Latitude +15°. To maximize efficiency in summer, the angle should be Latitude -15°. However, for an annual maximum production, the angle of the panel above horizontal should be equal to its latitude.[5]

[edit] Wind turbines

Main article: Wind power

The use of undersized wind turbines in energy production in sustainable structures requires the consideration of many factors. In considering costs, small wind systems are generally more expensive than larger wind turbines relative to the amount of energy they produce. For small wind turbines, maintenance costs can be a deciding factor at sites with marginal wind-harnessing capabilities. At low-wind sites, maintenance can consume much of a small wind turbine's revenue.[6] Wind turbines begin operating when winds reach 8 mph, achieve energy production capacity at speeds of 32-37 mph, and shut off to avoid damage at speeds exceeding 55 mph.[6] The energy potential of a wind turbine is proportional to the square of the length of its blades and to the cube of the speed at which its blades spin. Though wind turbines are available that can supplement power for a single building, because of these factors, the efficiency of the wind turbine depends much upon the wind conditions at the building site. For these reasons, for wind turbines to be at all efficient, they must be installed at locations that are known to receive a constant amount of wind (with average wind speeds of more than 15 mph), rather than locations that receive wind sporadically.[7] A small wind turbine can be installed on a roof. Installation issues then include the strength of the roof, vibration, and the turbulence caused by the roof ledge. Small-scale rooftop wind turbines have been known to be able to generate power from 10% to up to 25% of the electricity required of a regular domestic household dwelling.[8] Turbines for residential scale use are usually between 7 feet (2 m) to 25 feet (8 m) in diameter and produce electricity at a rate of 900 watts to 10,000 watts at their tested wind speed.[9]

[edit] Solar water heating

Main article: Solar thermal power

Solar water heaters, also called solar domestic hot water systems, can be a cost-effective way to generate hot water for a home. They can be used in any climate, and the fuel they use—sunshine—is free.[10]

There are two types of solar water systems- active and passive. An active solar collector system can produce about 80 to 100 gallons of hot water per day. A passive system will have a lower capacity.[11]

There are also two types of circulation, direct circulation systems and indirect circulation systems. Direct circulation systems loop the domestic water through the panels. They should not be used in climates with temperatures below freezing. Indirect circulation loops glycol or some other fluid through the solar panels and uses a heat exchanger to heat up the domestic water.

The two most common types of collector panels are Flat-Plate and Evacuated-tube. The two work similarly except that evacuated tubes do not convectively lose heat, which greatly improves their efficiency (5%-25% more efficient). With these

higher efficiencies, Evacuated-tube solar collectors can also produce higher-temperature space heating, and even higher temperatures for absorption cooling systems.[12]

Electric-resistance water heaters that are common in homes today have an electrical demand around 4500 kW·h/year. With the use of solar collectors, the energy use is cut in half. The up-front cost of installing solar collectors is high, but with the annual energy savings, payback periods are relatively short.[12]

[edit] Heat pumps

Air-source heat pumps (ASHP) can be thought of as reversible air conditioners. Like an air conditioner, an ASHP can take heat from a relatively cool space (e.g. a house at 70°F) and dump it into a hot place (e.g. outside at 85°F). However, unlike an air conditioner, the condenser and evaporator of an ASHP can switch roles and absorb heat from the cool outside air and dump it into a warm house.

Air-source heat pumps are inexpensive relative to other heat pump systems. However, the efficiency of air-source heat pumps decline when the outdoor temperature is very cold or very hot; therefore, they are only really applicable in temperate climates.[12]

For areas not located in temperate climates, ground-source (or geothermal) heat pumps provide an efficient alternative. The difference between the two heat pumps is that the ground-source has one of its heat exchangers placed underground—usually in a horizontal or vertical arrangement. Ground-source takes advantage of the relatively constant, mild temperatures underground, which means their efficiencies can be much greater than that of an air-source heat pump. The in-ground heat exchanger generally needs a considerable amount of area. Designers have placed them in an open area next to the building or underneath a parking lot.

Energy Star ground-source heat pumps can be 40% to 60% more efficient than their air-source counterparts. They are also quieter and can also be applied to other functions like domestic hot water heating.[12]

In terms of initial cost, the ground-source heat pump system costs about twice as much as a standard air-source heat pump to be installed. However, the up-front costs can be more than offset by the decrease in energy costs. The reduction in energy costs is especially apparent in areas with typically hot summers and cold winters.[12]

Other types of heat pumps are water-source and air-earth. If the building is located near a body of water, the pond or lake could be used as a heat source or sink. Air-earth heat pumps circulate the building's air through underground ducts. With higher fan power requirements and inefficient heat transfer, Air-earth heat pumps are generally not practical for major construction.

[edit] Sustainable building materials

See also: Green building

Some examples of sustainable building materials include recycled denim or blown-in fiber glass insulation, sustainably harvested wood, Trass, Linoleum,[13] sheep wool, concrete (high and ultra high performance[14] roman self-healing concrete[15]), panels made from paper flakes, baked earth, rammed earth, clay, vermiculite, flax linnen, sisal, seegrass, cork, expanded clay grains, coconut, wood fibre plates, calcium sand stone, locally obtained stone and rock, and bamboo, which is one of the strongest and fastest growing woody plants, and non-toxic low-VOC glues and paints.

[edit] Recycled materials

Recycling items for building

Sustainable architecture often incorporates the use of recycled or second hand materials, such as reclaimed lumber and recycled copper. The reduction in use of new materials creates a corresponding reduction in embodied energy (energy used in the production of materials). Often sustainable architects attempt to retrofit old structures to serve new needs in order to avoid unnecessary development. Architectural salvage and reclaimed materials are used when appropriate. When older buildings are

demolished, frequently any good wood is reclaimed, renewed, and sold as flooring. Any good dimension stone is similarly reclaimed. Many other parts are reused as well, such as doors, windows, mantels, and hardware, thus reducing the consumption of new goods. When new materials are employed, green designers look for materials that are rapidly replenished, such as bamboo, which can be harvested for commercial use after only 6 years of growth, sorghum or wheat straw, both of which are waste material that can be pressed into panels, or cork oak, in which only the outer bark is removed for use, thus preserving the tree. When possible, building materials may be gleaned from the site itself; for example, if a new structure is being constructed in a wooded area, wood from the trees which were cut to make room for the building would be re-used as part of the building itself.

[edit] Lower volatile organic compounds

Low-impact building materials are used wherever feasible: for example, insulation may be made from low VOC (volatile organic compound)-emitting materials such as recycled denim or cellulose insulation, rather than the building insulation materials that may contain carcinogenic or toxic materials such as formaldehyde. To discourage insect damage, these alternate insulation materials may be treated with boric acid. Organic or milk-based paints may be used.[16] However, a common fallacy is that "green" materials are always better for the health of occupants or the environment. Many harmful substances (including formaldehyde, arsenic, and asbestos) are naturally occurring and are not without their histories of use with the best of intentions. A study of emissions from materials by the State of California has shown that there are some green materials that have substantial emissions whereas some more "traditional" materials actually were lower emitters. Thus, the subject of emissions must be carefully investigated before concluding that natural materials are always the healthiest alternatives for occupants and for the Earth.[17]

Volatile organic compounds (VOC) can be found in any indoor environment coming from a variety of different sources. VOCs have a high vapor pressure and low water solubility, and are suspected of causing sick building syndrome type symptoms. This is because many VOCs have been known to cause sensory irritation and central nervous system symptoms characteristic to sick building syndrome, indoor concentrations of VOCs are higher than in the outdoor atmosphere, and when there are many VOCs present, they can cause additive and multiplicative effects.

Green products are usually considered to contain fewer VOCs and be better for human and environmental health. A case study conducted by the Department of Civil, Architectural, and Environmental Engineering at the University of Miami that compared three green products and their non-green counterparts found that even though both the green products and the non-green counterparts both emitted levels of VOCs, the amount and intensity of the VOCs emitted from the green products were much safer and comfortable for human exposure.[18]

[edit] Materials sustainability standards

Despite the importance of materials to overall building sustainability, quantifying and evaluating the sustainability of building materials has proven difficult. There is little coherence in the measurement and assessment of materials sustainability attributes, resulting in a landscape today that is littered with hundreds of competing, inconsistent and often imprecise eco-labels, standards and certifications. This discord has led both to confusion among consumers and commercial purchasers and to the incorporation of inconsistent sustainability criteria in larger building certification programs such as LEED. Various proposals have been made regarding rationalization of the standardization landscape for sustainable building materials.[19]

[edit] Waste management

Waste takes the form of spent or useless materials generated from households and businesses, construction and demolition processes, and manufacturing and agricultural industries. These materials are loosely categorized as municipal solid waste, construction and demolition (C&D) debris, and industrial or agricultural by-products.[20] Sustainable architecture focuses on the on-site use of waste management, incorporating things such as grey water systems for use on garden beds, and composting toilets to reduce sewage. These methods, when combined with on-site food waste composting and off-site recycling, can reduce a house's waste to a small amount of packaging waste.

[edit] Building placement

This section **does not cite any references or sources**. *(March 2011)*

One central and often ignored aspect of sustainable architecture is building placement. Although the ideal environmental home or office structure is often envisioned as an isolated place, this kind of placement is usually detrimental to the environment. First, such structures often serve as the unknowing frontlines of suburban sprawl. Second, they usually increase the energy consumption[*disambiguation needed*] required for transportation and lead to unnecessary auto emissions. Ideally, most building should avoid suburban sprawl in favor of the kind of light urban development articulated by the New Urbanist movement. Careful mixed use zoning can make commercial, residential, and light industrial areas more accessible for those traveling by foot, bicycle, or public transit, as proposed in the Principles of Intelligent Urbanism. The study of Permaculture, in its holistic application, can also greatly help in proper building placement that minimizes energy consumption and works with the surroundings rather than against them, especially in rural and forested zones.

[edit] Sustainable building consulting

Sustainable building consulting is a practice or service where an intermediary party or company is utilized as a way to forecast levels of sustainability during conceptual architectural stages. This forecasting consists of the identification of adherent building techniques and norms, as well as the identification of specific building materials.

Norms and standards have been justified by rating systems like LEED[21] and Energy Star for Homes[22] which are performance-based. They define benchmarks to be met and provide metrics and testing to meet those benchmarks. It is up to the parties involved in the project to determine the best approach to meet those standards.

[edit] Criticism

There are conflicting ethical, engineering, and political orientations depending on the viewpoints.[23]

[edit] See also


Architecture portal


Energy portal


Sustainable development portal

- Alternative natural materials
- BREEAM
- Building Automation
- Copper in architecture: sustainability and recylability
- Deconstruction (building)
- Digital morphogenesis
- Earthship
- Ecological design
- Ecological footprint
- Energy-plus-house
- Fab Tree Hab: 100% Ecological Home
- Green building
- Green Globe
- Haute qualité environnementale French standard for green building - HQE

- Life cycle assessment
- Low-energy house
- New Urbanism
- Organic architecture
- Passive house
- Principles of Intelligent Urbanism
- QSAS
- Renewable heat
- Reuse
- Solar chimney
- Solar energy
- Straw-bale construction
- Superinsulation
- Sustainable design
- Sustainable development
- Sustainable landscape architecture
- Sustainable preservation
- Sustainable refurbishment
- Vernacular architecture
- Windcatcher
- Zero-energy building
- Michelle Kaufmann

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[edit] External links

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- World Green Building Council
- DuBo lijst NL Dutch portal on sustainable building
- Ecobox Norwegian portal on sustainable architecture
- El Paso Solar Energy Association Information page about passive solar water heating
- Energy Recovery Council
- Eco Architecture Wiki A database showing examples of sustainable architecture in various countries
- Solaripedia Green Architecture & Building
- Fifteen Green Buildings
- Passivhaus Institut German institute for passive buildings
- Passive House NZ Passive House New Zealand
- The Sustainable Performance Institute The Sustainable Performance Institute Green Building Consulting Non-Profit Organization
- Sustainable Architecture and Simulation Modelling
- Sustainable Architecture Information from the University of Michigan

- Sustainable Buildings Industry Council
- 10 Sustainable Buildings
- The NEXT Building Standard
- U.S. EPA - Landfill Research Bioreactor landfill research supports sustainable waste management initiatives
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Sustainable Laboratory Design

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Introduction

A typical laboratory currently uses five times as much energy and water per square foot as a typical office building. Research facilities are so energy demanding for a variety of reasons:

- They contain large numbers of containment and exhaust devices;
- They house a great deal of heat-generating equipment;
- Scientists require 24–hour access; and
- Irreplaceable experiments require fail-safe redundant backup systems and uninterrupted power supply (UPS) or emergency power.

In addition, research facilities have intensive ventilation requirements—including "once through" air—and must meet other health and safety codes, which add to energy use. Examining energy and water requirements from a holistic perspective, however, can identify significant opportunities for improving efficiencies while meeting or exceeding health and safety standards. Sustainable design of lab environments should also improve comfort and worker productivity.

Chilled beams are an excellent opportunity to use new technology to reduce air change rates but not jeopardize safety. NIH conducted a two year study and determined that chilled beams were the best value for the second phase of their neuroscience facility. The image to the right is from Oklahoma Medical Research Facility (OMRF) with chilled beams installed. The square shaped panel in the ceiling is the chilled beam.

Another approach gaining popularity in the last few years is a chemical sensor system to manage air change rates more efficiently. The Texas Children's Hospital has been up and running since the beginning of 2011. With the chemical sensors the entire building as been running at slightly less than 4 air change rates for the entire year This is a significant savings and the cost of the system had a payback of slightly less than a year.

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Description

The key aspects of sustainable laboratory design include:

- Increased energy and water conservation and efficiency
- Reduction or elimination of harmful substances and waste
- Improvements to the interior and exterior environments, leading to increased productivity
- Efficient use of materials and resources
- Recycling and increased use of products with recycled content

See WBDG Sustainable Branch for more details on the principles of sustainable design.

The following table is an example of a sustainable design criteria chart set up for a specific laboratory project. Each criterion must be reviewed for each specific project.

Sustainable Design Criteria				
Parameter	**Code Minimum**	**Code Reference**	**Standard Practice**	**Design Target**
Ventilation	10 cfm/person	ASHRAE 62/89	Same	Maximize outdoor air in the breathing zone
Filtration	none		35-80%	65% pre filter 85% final filter
Indoor Design Temperature	75° F summer 72° winter		Same	
Humidity Control	uncontrolled		uncontrolled	60% RH summer 40% RH winter
Equipment Heat Dissipation	NA		3-4W/sf	1.5W/sf or 2W/sf with 75% diversity factor
Toilet Exhaust	50 cfm/fixture	ASHRAE 62/89	Same	2 cfm/sf
Connected Lighting Heat Load	NA		2W/sf	0.5-0.75W/sf Total task/ambient with occupancy sensors and daylight sensors
Lighting Levels	100 ft. candles all direct		Same	20-30 ft. candles with ambient and task lighting
Building Shell Infiltration	6"/100 sf	ASHRAE guideline	3"/100 sf	1.5"/100 sf (Canadian Standard)
Building Shell Infiltration (alternate)	0.60 cfm/sf	ASHRAE guideline	0.30 cfm/sf	0.10 cfm/sf
Exterior Wall Insulation	U = 0.28 btu/sf-hr-F	BOCA Energy Code	0.10 btu/sf-hr-F	U = 0.15 btu/sf-hr South U = 0.05 btu/sf-hr (N, E, W)
Exterior Wall Moisture Control	none			AIB - with insulation both sides
Roof Insulation	U - 0.07 btu/sf-hr	BOCA Energy Code	U - 0.05 btu/sf-hr-F	U - 0.05 btu/sf-hr- F with low albedo surfacing

Windows				
Glazing type	Single/clear		Double/clear	heat reflecting clear
Visible transmittance	0.80		0.78	0.70
Shading Coefficient	1.00		0.80	0.43
U value	1.04		0.48	0.30
Heat Degree Days	6,155 btu	ASHRAE	Same	Determined by DOE-2 or other energy analysis of TMY data

A. Architectural Considerations

The design of the building envelope—including overhangs, glazing, insulation, and (possibly) the use of photovoltaic panels—plays a large role in the research facility's energy efficiency.

The stepped design at CDC Building 110 Facility provides overhangs and light shelves to shade and direct natural light into the office spaces inside.

Overhangs

Overhangs for shading windows are often designed as part of the wall system to improve the quality of the natural light entering the interior space. The south elevation should have a horizontal overhang; east and west elevations usually require both horizontal and vertical overhangs. See also WBDG Sun Control and Shading Devices.

Glazing

The glazing material for exterior windows should have a thermal break and an insulating section between the inner and outer sections of the frames. Wood or fiberglass frames will give much better thermal performance than aluminum. Low-E windows with at least an R-3 insulation value should be used. "Superwindows" that incorporate multiple thin plastic films can have an R value as high as 12. The problem is that such windows cost up to four times as much as low-E glass. Operable windows generally will not reduce energy costs; in fact, they may increase energy usage, but they usually enhance the quality of the indoor environment and are therefore preferred by most clients. See also WBDG Windows and Glazing.

Roofs and Walls

The use of light-colored roofing with a high-albedo coating to reflect light and heat is recommended. The amount of wall and roof insulation needed will vary depending on the climate and the type of lab. For example, equipment-intensive labs will generate a lot of heat and in certain parts of the country will not require as much roof insulation as elsewhere. All electrical outlets and all plumbing and wire penetrations into the building should be sealed, since air leakage can be a significant source of energy waste as well as moisture problems in some parts of the country.

Today, there is quite a bit of discussion about using photovoltaic panels both to enclose a building and to generate electricity. Photovoltaic panels can be integrated into the building envelope as metal roofing, spandrel glazing, or semi-transparent vision glazing. See WBDG Building Integrated Photovoltaics (BIPV) But the panels are difficult to justify in traditional applications because the electricity they generate can cost more than electricity purchased from the grid.

B. Engineering Considerations

Sustainable engineering addresses civil engineering concerns as well as the design of mechanical, plumbing, and lighting systems. First and foremost, the design team and client should contact the local utility company to explore opportunities for rebates to assist in the purchase of high-efficiency equipment or the implementation of other energy conservation measures.

Civil Engineering

Civil engineering issues to consider include the use of pervious materials and light colored wherever possible. In preparing a site for new construction, designers should consider transplanting existing trees instead of removing them. Proper storm water management strategies are also important to reduce erosion and replenish local aquifers. See also WBDG Sustainable—Optimize Site Potential and Achieving Sustainable Site Design through Low Impact Development Practices.

Mechanical, Plumbing, and Water Conservation Strategies

For the HVAC system, it is most important to simulate the operation of the whole system and to analyze assumptions using whole-building systems analysis software such as DOE-2. See also Laboratories for the 21st Century: Energy Analysis (PDF 1.6 MB). Reducing building loads is critical to improving

energy efficiency, and one key way to reduce loads is to reduce the amount of outside air used for ventilation. This raises a design challenge, however, since air supplied to laboratories is exposed to chemical contaminants and therefore cannot be returned to the central air handling system and must be exhausted. The volume of ventilation air required for the laboratories is typically greater than that for classrooms, lecture halls, and offices. One strategy to utilize outside air efficiently is to install a mechanical unit that introduces 100 percent outside air into classrooms and lecture halls. Return air from these areas is reconditioned through the mechanical system and then ducted to the laboratories as supply air. The supply air to the laboratories is exhausted. In this way, the outside air is used twice before being exhausted. Note that this strategy may reduce the ability to transform classrooms into lab spaces in the future.

Numerous strategies can be employed for improving the energy efficiency of cooling, heating, and plumbing systems:

- Insulate hot water, steam, and chilled water piping.
- Maintain condenser water as cool as possible, but not less than 20 degrees above chilled water supply temperature.
- Reuse wasted heat with a heat recovery system.
- Install an economizer at the boiler. (The water-side economizer will help with humidity controls.)
- Maintain hot water for washing hands at 105 degrees F. Consider using local hot water tanks at kitchens, restrooms, and other areas instead of central hot water.
- For plumbing systems, consider using ultra-low-flow toilets (0.5 gallons per flush), waterless urinals, dual flush toilets, ultra-low-flow lavatory faucets, and automated controls such as infrared sensors for faucets.
- Harvesting rainwater and reusing "gray water" from sinks for irrigation may help reduce water costs.

See also WBDG—High Performance HVAC.

Sustainable Lighting Design

Sustainable lighting design reduces energy use while enhancing employee comfort and productivity. Sustainable lighting strategies include the use of compact fluorescents (CFLs) rather than incandescent lamps, maximizing natural daylighting throughout a facility, and employing various photosensing technologies to conserve energy.

Incandescent lamps are extremely inefficient, energy-wise, using only 10 percent of the energy they consume to produce light (the rest is given off as heat). CFLs should be used instead. Research office lighting can be less than 0.75 watts/sf. connected load, and with lighting controls it may consume less than 0.5 watts/sf. Where functional requirements permit, lighting design should combine task and ambient lighting to reduce the high overall light levels. Good task lighting lessens glare and eyestrain. See also WBDG Energy Efficient Lighting.

LED lighting works extremely well for task lighting. See images below of a flexible and energy efficient task light. Overhead task light with LEDs should be to market by 2015. Now it is widely accepted to have 50 foot candles for ambient lighting.

There are a wide range of shapes and options for lighting and when done well are nice design amenities as shown here at OMRF.

Daylighting

Maximizing the availability of natural daylight is an important principle of sustainable design. Not only does it reduce energy use, but it also increases comfort and enhances productivity. Designers should strive to direct natural light into most laboratory spaces and public areas so that, from almost anywhere in the building, people have the opportunity to look outdoors to see what the weather is like and orient themselves to the time of day. Wherever possible, daylighting should be the primary source of illumination; artificial lighting should be thought of as a supplement to, rather than a replacement for, daylighting.

Typically, the first 15 feet of depth at the perimeter of the building can be entirely lit by daylight during the daytime. The use of light shelves can extend the daylight zone as far as 45 feet into the building. Clerestory windows and skylights can be used to get even more natural daylight into the building. See also WBDG Daylighting.

Daylighting control systems determine the amount of light available in a given space and switch off one or more banks of lights whenever there is enough sunlight. Both full-range and step fluorescent dimming systems work well.

Lighting Controls

A key principle to remember in regard to lighting control systems is "simpler is better." Some systems employ photosensing technologies. Photosensing devices can control off-on for exterior lights, triggering fixtures to add light to a particular area when light levels decline. Also, a number of new fluorescent and metal halide fixtures are available that employ daylight harvesting—storing solar energy in the fixture during daylight hours and then using that energy to run the lamp when daylight diminishes; outdoor lighting systems can easily be retrofitted for these fixtures.

Other photosensing technologies include programmable low-voltage control systems and occupancy sensors. The programmable low-voltage systems can control individual areas of the building or an entire building with one switch. These systems interface with the building automation and dimming systems. They are flexible, can easily accommodate building changes, have a local override capability, and can be used for large or small systems.

Occupancy sensors typically have a one-to-two-year payback. The sensors are designed with adjustable sensitivity levels and timing. There are two technologies: passive infrared and ultrasonic. Passive infrared sensors detect movement of heat between zones. They must have "a line of sight" to detect people in the lab. Ultrasonic occupancy sensors work by broadcasting ultrasonic sound waves, analyzing the returning waves and detecting movement through Doppler shifts. They are effective for larger rooms and can cover a 360-degree area. One problem is that air turbulence can trigger their operation. All occupancy sensor systems must be designed correctly to avoid nuisance operation. See also WBDG Electric Lighting Controls.

C. Other Sustainability Issues

"Green" Products

Some casework products now being manufactured are considered "green." Examples include hardwood, veneer, and plywood products that originate from certified sustainable forests. Steel products can also be "green"—for example, steel laboratory casework and fume hoods made of sheet metal that contains 20 to 25 percent scrap steel. (Sixty percent of the scrap steel comes from old cars and appliances, the other 40 percent from manufacturing fall-off.) There is one problem with recycled steel's "greenness," however: recycling steel is highly energy-intensive, which raises the question whether energy conservation or resource conservation is the better environmental/sustainable strategy. See also WBDG Sustainable—Use Greener Materials and Using LEED on Laboratory Projects.

Other Issues

Other sustainable design issues include direct digital control energy management systems, and commissioning the entire building to ensure that building systems are operating as efficiently as possible.

Buildings should be designed with long-term flexibility options, such as the lab module for all architectural and engineering systems, easy connects and disconnects to the engineering systems, and flexible casework. Computers that turn themselves off during non-working hours reduce energy use and cost by reducing cooling loads and electrical demands. Laptop computers use one-tenth the energy of desktop PCs.

Clients are pushing project design teams to create research laboratories that are responsive to current and future needs; that encourage interaction among scientists from various disciplines; that help recruit and retain qualified scientists; and that facilitates partnerships and development. As such, a separate WBDG Resource Page on Trends in Lab Design has been developed to elaborate on this emerging model of laboratory design.

D. Conclusion

All the architectural, engineering, and other sustainability issues should be studied on a project-by-project basis. Factors such as the client's specific goals, the type of lab being designed, the part of the country where the lab is located, and its position on the site will lead to different solutions. See also "Whole Buildings" Design Approach.

The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) have launched a new, voluntary program to improve the environmental performance of U.S. laboratories called the Laboratories for the 21st Century (Labs21) initiative. Labs21 is designed to improve laboratory energy and water efficiency, encourage the use of renewable energy sources, and promote environmental stewardship. Also available is the Labs21 Environmental Performance Criteria (EPC), a rating system specifically designed to assess the environmental performance of research facilities.

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Application

Representative Examples

Numerous facilities have implemented high-performance design features into new or retrofit laboratory projects. Labs21 has developed the following case studies:

- Fred Hutchinson Cancer Research Center
- Lawrence Berkeley National Laboratory In-House Energy Management Program
- National Institutes of Health (NIH) Louis Stokes Laboratories-Building 50
- Nidus Center for Scientific Enterprise, St. Louis, MO
- Pharmacia Corporation Pharmacia Building Q
- Sandia National Laboratories Process and Environmental Technology Laboratory (PETL)
- State of Georgia, Dept. of Public Health Georgia Public Health Laboratory
- U.S. Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory

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Relevant Codes and Standards

Federal Mandates

- Energy Policy Act of 2005(PDF 1.9 MB)
- Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management"

The following agencies and organizations have developed codes and standards affecting the design of research laboratories. Note that the codes and standards are minimum requirements. Architects, engineers, and consultants should consider exceeding the applicable requirements whenever possible.

- OSHA Standards
  - 29 CFR 1910.1000, Air Contaminants
    - 29 CFR 1910.1000 Table Z-1, Table Z-1 Limits for Air Contaminates
  - 29 CFR 1910.1450, Occupational exposure to hazardous chemicals in laboratories
    - 29 CFR 1910.1450 App A, National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

- 29 CFR 1910.1450 App B, References (Non-Mandatory)

- *ANSI/AIHA—American National Standard Z9.5 for Laboratory Ventilation*
- Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) Standards
- Department of Health and Human Services, Centers for Disease Control and Prevention and National Institutes of Health—*Biosafety in Microbiological and Biomedical Laboratories, 5th Edition*, 2009.
- Department of Veterans Affairs—*Research Laboratory Design Guide*
- *Facilities Standards for the Public Buildings Service, P100* by the General Services Administration (GSA).
- National Institutes of Health—*NIH Design Policy and Guidelines*
- National Institutes of Health (NIH)—*Guidelines for the Laboratory Use of Chemical Carcinogens, Pub. No. 81-2385*
- *ISEA Z358.1—Emergency Eyewash and Shower Equipment*
- *NFPA 30—Flammable and Combustible Liquids Code*
- *NFPA 45—Fire Protection for Laboratories using Chemical*
- Tri-Services Unified Facilities Guide Specifications (UFGS)—UFGS, organized by MasterFormat™ divisions, are for use in specifying construction for the military services. Several UFGS exist for safety-related topics.

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Additional Resources

The Federal Requirements

EPA first developed a green buildings vision and policy statement in 1995 and since then the Agency has endeavored to continue leading by example. The following federal statuses require EPA to build, renovate, operate, maintain, and use green buildings:

- Energy Policy Act of 2005 (EPAct 2005)
- The Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (*Guiding Principles*)
- Exeutive Order (EO) 13423
- Energy Independence and Security Act of 2007 (EISA)
- Executive Order (EO) 13514

Energy Policy Act of 2005 (EPAct 2005)
EPAct 2005 requires federal buildings to be designed to achieve energy consumption levels that are at least 30 percent below the American Society of Heating, Air Conditioning, and Engineering (ASHRAE) 90.1-2004 standard, and to apply sustainable design principles to the siting, design, and construction of all new replacement buildings.

The Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (*Guiding Principles*)
EPA signed the *Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (MOU)*, along with 21 other agencies, which voluntarily committed the Agency to follow the *Guiding Principles*. The *Guiding Principles*, last revised in December 2008, focus on the following five topic areas for both new construction and major renovations:

- Employ integrated design principles (new construction)/Employ integrated assessment, operation, and management principles (existing buildings)
- Optimize energy performance
- Protect and conserve water
- Enhance indoor environmental quality
- Reduce environmental impact of materials

Download the Guiding Principles from FedCenter.gov

Executive Order (EO) 13423
EO 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," was the first executive order to require federal agencies to implement the *Guiding Principles* in all new construction and major renovation projects and in at least 15 percent of their existing building inventory (by number of buildings) by the end of FY 2015. In addition, it requires agencies to reduce energy intensity by 3 percent per year, or 30 percent by FY 2015 (compared to an FY 2003 baseline).

Energy Independence and Security Act of 2007 (EISA)
EISA reinforces the energy reduction goals for federal agencies put forth in EO 13423 and introduces a set of more aggressive sustainability requirements. EISA Section 432 requires agencies to complete comprehensive energy and water evaluations at 25 percent of the agency's "covered facilities"—major agency facilities that comprise at least 75 percent of the agency's facility energy use—annually. EISA encourages agencies to implement and verify energy and water efficiency measures identified by these evaluations, and requires that very four years agencies return to conduct recommissioning and look for new energy-saving opportunities.

EISA also requires new or renovated agency building designs to reduce fossil fuel-generated energy consumption compared to an FY 2003 baseline. The required reduction increases such that designs for new buildings or major renovations begun in FY 2030 must reduce fossil fuel-generated energy consumption by 100 percent, equivalent to using zero net energy, compared to an FY 2003 baseline. Starting in 2010, federal agencies are also required to lease space that has earned the ENERGY STAR label in the most recent year.

Executive Order (EO) 13514
EO 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," requires that starting in fiscal year (FY) 2020 federal buildings be designed to achieve "zero net energy" by FY 2030. It reiterates EO 13423's requirement that new construction and major renovations meet the *Guiding Principles*, and that 15 percent of an agency's existing buildings and leases meet the *Guiding Principles* by FY 2015. EO 13514 requires agencies to reduce energy, water, and material use through cost-effective strategies and operations and maintenance (O&M) procedures, and to make annual progress toward 100 percent conformance with the *Guiding Principles* for their building inventories.

WBDG

Building / Space Types

Office Building, Research Facilities, Animal Research Facility, Research Laboratory, Academic Laboratory, Government Laboratory, Private Sector Laboratory, Laboratory: Dry, Laboratory: Wet

Design Objectives

Accessible, Aesthetics, Cost-Effective, Functional / Operational, Productive, Secure / Safe, Sustainable

Products and Systems

Federal Green Construction Guide for Specifiers

Project Management

Building Commissioning

Tools

LEED® Version 2.1 Credit / WBDG Resource Page Matrix, LEED®-DoD Antiterrorism Standards Tool

Publications

- *Building Type Basics for Research Laboratories* by Daniel Watch. New York, NY: John Wiley & Sons, Inc., 2001. ISBN# 0-471-39236-7.
- *GSA LEED® Applications Guide*
- *GSA LEED® Cost Study*
- *Laboratory Design, Construction, and Renovation: Participants, Process, and Product* by National Research Council, Committee on Design, Construction, and Renovation of Laboratory Facilities. Washington, DC: National Academy Press, 2000.

Organizations

- Sustainable Buildings Industry Council (SBIC)
- U.S. Green Buildings Council (USGBC)
    - Leadership in Energy and Environmental Design (LEED®) Green Building Rating System, USGBC

- Federal Energy Management Program (FEMP), DOE
- Laboratories for the 21st Century (Labs21)—Sponsored by the U.S. Environmental Protection Agency and the U.S. Department of Energy, Labs21 is a voluntary program dedicated to improving the environmental performance of U.S. laboratories.
    - Labs21 Tool Kit
        - A Design Guide for Energy-Efficient Research Laboratories—A reference that helps facility owners, managers, and designers and apply energy-efficiency features in laboratories.
        - Environmental Performance Criteria—A rating system specifically designed to assess environmental performance of laboratories.

Sustainable Design Through BIM and Analysis

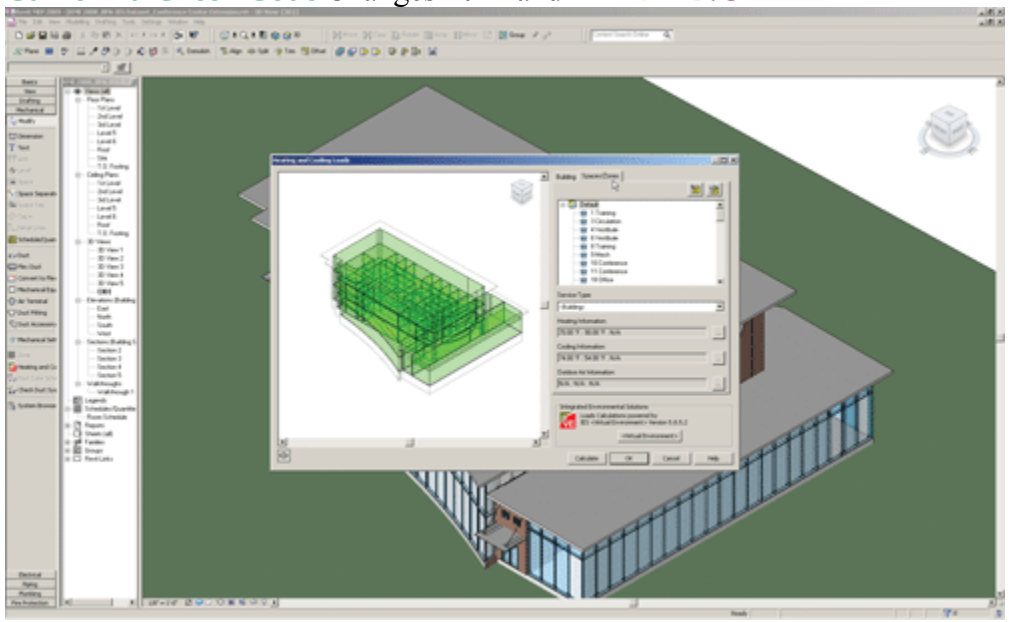
Oct 21, 2008 11:19 AM, By Robert E. Middlebrooks, AIA

Building-information-modeling-based design tools help mechanical engineers provide ‘greener' building systems

In the United States, buildings are responsible for almost half of all annual greenhouse-gas emissions and consume about three-fourths of the electricity generated by power plants. That, coupled with the fact that the majority of the buildings in which we will live and work over the next 30 years have not yet been built means we have significant opportunity to reduce the carbon footprint of buildings and stem climate change.

The sustainability of a new building is based on many factors, including water savings, energy efficiency, and materials selection. These factors are influenced heavily by a building's architectural, site, and building-systems design and supporting civil infrastructure. Mechanical engineers can support sustainable design by providing input about green approaches early in the design process, designing more efficient and better-sized mechanical systems, and producing metrics and supporting documentation for evaluation and green certification when needed.

This article will describe how building-information modeling (BIM) and BIM-based design tools enable mechanical engineers to simulate, analyze, and document their designs more efficiently and accurately and ultimately deliver greener building systems and healthier, more resource-efficient buildings.



Building-information modeling streamlines the design and analysis process, allowing designers to evaluate design alternatives quickly and make better decisions for greener designs.

Sustainable MEP Design

Drivers for green design are numerous and include owner demand and a growing attitude toward environmental stewardship within the building industry, not to mention a host of government regulations and green-building incentives. The federal government, as well as many states and local communities throughout the country, have initiated programs and enacted legislation regarding green-building design. For example, the Energy Policy Act of 2005 provides financial incentives for sustainable building. Title 24, Part 6, Energy Efficiency Standards for Residential and Nonresidential Buildings, of the California Code of Regulations sets minimum energy-efficiency standards for all new homes, additions to and alterations of existing homes, and most commercial buildings. New York City Local Law 86, also known as the Green City Buildings Act, requires that new municipal buildings and additions to and renovations of existing municipal buildings meet green-building standards.

Standards and rating systems for green-building systems abound. In the United States, ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, is a widely used standard providing minimum requirements for energy-efficient building systems in new and renovated buildings. The U.S. Green Building Council's

Leadership in Energy and Environmental Design (LEED) Green Building Rating System is the most prevalent scorecard used by those pursing green-building certification. Of the 69 total LEED credits available, approximately 25 percent are influenced by building-systems design.

Internationally, the trend toward sustainable-building design also is strong. Governments around the globe are implementing new building regulations that mandate sustainable design. Many countries already require performance assessments to comply with building regulations. Additionally, countries around the world have or are adopting voluntary rating systems similar to the LEED rating system, such as Green Globes (Canada), Building Research Establishment Environmental Assessment Method (England), Comprehensive Assessment System for Building Environmental Efficiency (Japan), and Green Star (Australia).

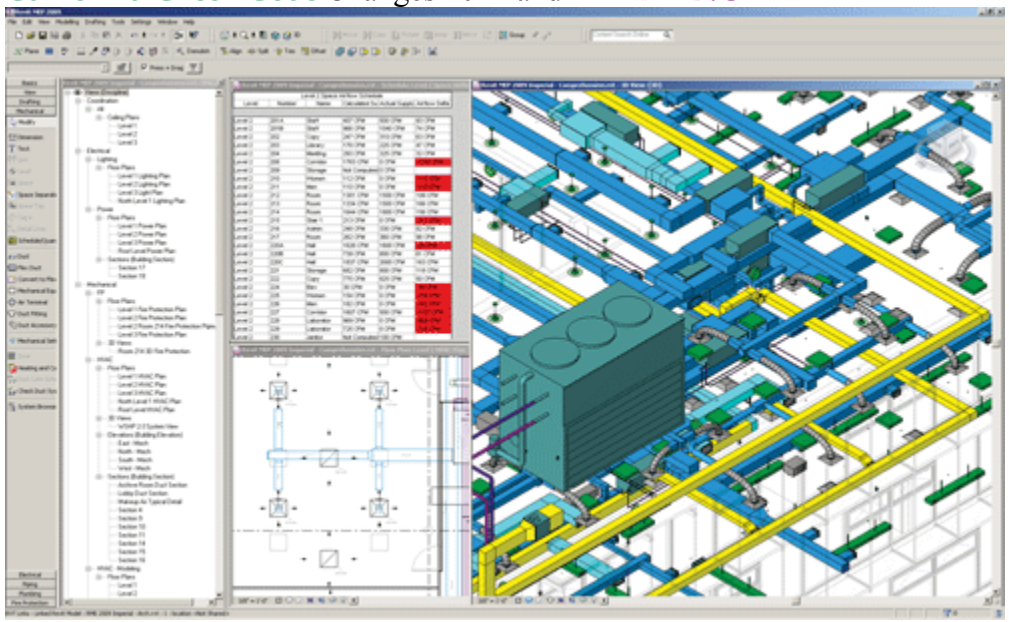
Although the building industry's (and owners') interest in sustainable design is undeniable, it has its challenges. Some issues are technical, while others relate to standard industry processes and practices. Cost always is a concern. However, the growing market demand for sustainable design is outweighing and overcoming these hurdles and driving fundamental process changes throughout the industry. Transformative concepts that facilitate sustainable design, such as integrated project delivery and BIM, quickly are becoming the standard.

BIM

BIM is an approach to building design involving the use of a digital building model created from coordinated, consistent design information enabling whole-building analysis, faster decision-making, and better documentation.

BIM software offers many benefits for general building design. The best BIM software uses a centralized, parametric model allowing "live" viewing and automatic coordination of all plans, quantity takeoffs, and other related documentation. These integrated deliverables have explicit relationships with each other and the model, resulting in better-coordinated construction documents that minimize errors and omissions.

The design model is used for a variety of building analyses, automatic clash detection, design visualizations, and precise quantity takeoffs. In addition, the resulting digital design model can be leveraged for a variety of related tasks, such as construction sequencing, digital fabrication, and facilities management.



Purpose-built BIM software uses a centralized, parametric model that results in well-coordinated construction documents, minimizing errors and omissions.

BIM and Sustainable Design

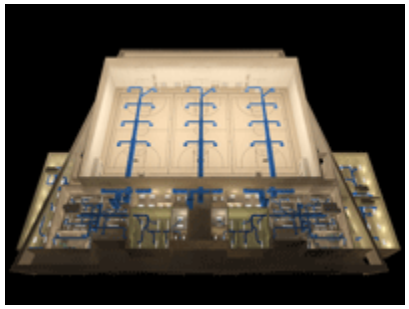
Perhaps the greatest advantage of BIM in sustainable building design is building analysis. Sustainable building design hinges on the ability to gain insight into a building's performance through design analysis and optimization. But evaluating building performance based on the building representations produced by conventional computer-aided-design (CAD) or object-CAD solutions requires a great deal of human intervention and interpretation and makes the analyses unduly time-consuming and costly.

With BIM, much of the data needed to support performance analysis is captured naturally as design proceeds. With BIM, designers can analyze how a building will perform, even in the early stages of design. Armed with this information, they can evaluate design alternatives quickly and make better decisions for greener designs. By streamlining design and analysis, BIM facilitates the calculations needed to optimize building performance.

A BIM-based design model carries a wealth of information necessary for many other aspects of sustainable design. For example, the ability to create drawings and details directly from a model (and have the software automatically coordinate these drawings

and details with the model) improves the efficiency and accuracy of green certification. Schedules of building-material quantities can be obtained directly from a model to determine percentages of material reuse, recycling, and salvage. Various design options for sustainability can be pursued in parallel and automatically tracked in a model. Advanced visualization techniques can be used for solar studies and to produce 3-D renderings and construction animations of a green project. A digital 3-D model supports better understanding and collaborative communication among the various stakeholders in a green partnership (the architect, owner, consultants, review bodies, etc.).

Sustainable-Design Process



An accurate digital building model integrated with energy-analysis tools greatly simplifies daylighting analysis on sustainable design projects and allows engineers to size building systems properly.

To illustrate how BIM facilitates green building-systems design, let's examine a typical BIM-based workflow.

To begin building-systems design, a mechanical-engineering consultant leverages the architectural design model. By using the architect's model, the mechanical engineer ensures that the building-mechanical-systems design and model are coordinated, eliminating a redundant modeling effort to recreate the architect's building geometry.

The mechanical engineer defines all of the heating/cooling spaces and zones, adds information--such as the number of people per room, the heat load from equipment in the room (for example, the number of computers), etc.--and exports that model to an XML file. In addition to space and zone information, this file captures building geometry and other information, such as lighting density, sensible- and latent-load contributions, building-construction thermal properties, desired room-temperature set points, required ventilation airflow, cooling-coil temperature, heating-coil temperature, etc. As such, the file represents an accurate thermal model of the project.

The file then is imported into an analysis package, which determines the building's energy usage and heating- and cooling-load calculations. With their own design model leveraged directly for analysis, mechanical engineers avoid the time-consuming, error-prone task of manually entering data into an analysis solution.

Once the analysis is done, the resulting data can be viewed in a report and exported to a BIM-based mechanical, electrical, and plumbing (MEP) design model. For example, all of the heating- and cooling-load requirements for each space are exported to the MEP design model, enabling the mechanical engineer to view the information via the BIM software and use the software's calculations to size equipment, ductwork, piping, etc.

The mechanical engineer then can use "what-if" design scenarios, such as changing the R-values of various walls, to see how the changes would affect the total energy usage of the building.

Some BIM software includes built-in analysis tools that can be used to accurately predict a building's peak heating and cooling loads. This allows engineers to quantify needed airflow and properly size HVAC equipment, ensuring that energy is not wasted powering oversized equipment.

This design/analysis/optimization workflow is typical of BIM-based practices. Analysis packages with tighter integration are on the horizon. For example, some BIM software platforms feature programmatic links--which do not require export/import to a neutral file format--to analysis-software solutions. By further streamlining design/analysis workflows, these integrations facilitate conceptual-stage inline analysis and enable more complete information pathways. In addition, even enhancements to construction techniques, such as streamlining direct digital fabrication of ductwork to reduce material waste, are becoming more prevalent.

Sustainable Design in Practice

Design West Engineering is a full-service MEP consulting firm based in San Bernardino, Calif. Established in 2000, the firm specializes in mechanical-, electrical-, and telecommunication-engineering applications and energy-efficiency projects for a range of building sectors, including education, medical, civic, residential, and commercial.

To facilitate a new level of project collaboration with its architectural clients and structural engineers and transform its sustainable-design practices from ad-hoc to technology-based, Design West adopted BIM software in early 2007. The firm has completed construction documentation on 12 projects using BIM.

One of Design West's current projects is a new $110 million, 340,000-sq-ft educational facility for Coachella Valley Unified School District in Indio, Calif. Scheduled for occupancy in the fall of 2011, the facility will house approximately 3,700 middle- and high-school students. The facility will consist of nine structures and include 104 classrooms, an administrative building, two gymnasiums with basketball courts, an outdoor swimming pool with a changing facility, and an outdoor stadium with two concession facilities. The campus is being designed to earn points under the Collaborative for High Performance Schools (CHPS) High Performance School Recognition and Rating Program, a sustainable-design rating system for K-12 schools in California. Therefore, the entire campus design will be analyzed rigorously to increase its energy performance.

"A large portion of the target CHPS points are related to energy efficiency," Joel Londenberg, a project manager for Design West, said. "So our mechanical design must be analyzed in the context of how the building envelope is constructed, including windows, walls, roofs, and so on."

For this project, the entire design team, including the MEP firm, architect, and structural-engineering firm, collaborated on a single BIM platform. Design West is able to leverage the architectural and structural project models for its building-systems design, as well as for cross-discipline clash detection and coordination.

"It's also possible to use the architect's model in conjunction with energy-analysis software to optimize the building-energy performance early in the design phase of the project," Londenberg said.

For example, Design West's engineers need to properly account for daylighting and its effects on the heating, cooling, and lighting requirements of individual spaces in the facility. The desert climate of Coachella Valley, Calif., makes it particularly important to balance the desire to bring light into a classroom with the need to keep heat out. An accurate digital building model integrated with energy-analysis tools greatly simplifies this daylighting analysis and allows Design West engineers to size the cooling system properly and perform the compliance calculations needed to meet building codes.

"By knowing accurate heating and cooling loads, we're able to right-size the equipment to improve indoor-air quality, improve thermal comfort, and improve overall energy usage," Londenberg said.

"This sophisticated level analysis in the design phase cannot be achieved easily without BIM," Londenberg said. "By using BIM, we're able to consider the building in greater detail earlier in the design, which allows for a more thorough design process and provides a new level of design coordination and collaboration that was never possible before."

Conclusion

Growing awareness of the impact of buildings and infrastructure on the environment has increased the need for building-industry professionals to embrace sustainable practices. Sustainable design is a major trend driving process change within our industry, requiring a workflow that provides more information earlier in the design process. BIM is poised to facilitate this change because it enables an integrated design workflow, linking design and analysis.

As the use of BIM in the building industry grows, building designs and outcomes will become more accurate, buildable, predictable, and sustainable, enabling the cost-effective design and delivery of healthy, resource-efficient buildings and mitigating the carbon footprint of our built environment.

For past HPAC Engineering feature articles, visit www.hpac.com.

Robert E. Middlebrooks, AIA, is an industry manager with Autodesk Inc., a provider of building-information modeling and technology for the architecture, engineering, and construction industries. An architect with more than 26 years of experience and formerly a principal of a 360-person architectural/engineering firm, he has led design projects, including collaborative design-build and developer-led integrated projects, in more than 14 countries in Europe, Africa, the Middle East, and the Caribbean.

Sustainable planning

Urban planners that are interested in achieving sustainable development or sustainable cities use various design principles and techniques when designing cities and their infrastructure. These include Smart Growth theory, Transit-oriented development, sustainable urban infrastructure and New Urbanism. Smart Growth is an urban planning and transportation theory that concentrates growth in infill sites within the existing infrastructure of a city or town to avoid urban sprawl; and advocates compact, transit-oriented development, walkable, bicycle-friendly land use, including mixed-use development with a range of housing choices. Transit-oriented development attempts to maximise access to public transport and thereby reduce the need for private vehicles. Public transport is considered a form of Sustainable urban infrastructure, which is a design approach which promotes protected areas, energy-efficient buildings, wildlife corridors and distributed, rather than centralized, power generation and waste water treatment. New Urbanism is more of a social and aesthetic urban design movement than a green one, but it does emphasize diversity of land use and population, as well as walkable communities which inherently reduce the need for automotive travel.

Both urban and rural planning can benefit from including sustainability as a central criterion when laying out roads, streets, buildings and other components of the built environment. Conventional planning practice often ignores or discounts the natural configuration of the land during the planning stages, potentially causing ecological damage such as the stagnation of streams, mudslides, soil erosion, flooding and pollution. Applying methods such as scientific modelling to planned building projects can draw attention to problems before construction begins, helping to minimise damage to the natural environment.

Cohousing is an approach to planning based on the idea of intentional communities. Such projects often prioritize common space over private space resulting in grouped structures that preserve more of the surrounding environment.

Watershed assessment of carrying capacity; estuary, riparian zone restoration and groundwater recharge for hydrologic cycle viability; and other opportunities and issues about Water and the environment show that the foundation of smart growth lies in the protection and preservation of water resources. The total amount of precipitation landing on the surface of a community becomes the supply for the inhabitants. This supply amount then dictates the carrying capacity - the potential population - as supported by the "water crop."

Sustainable architecture

Sustainable architecture is the design of sustainable buildings. Sustainable architecture attempts to reduce the collective environmental impacts during the production of building components, during the construction process, as well as during the lifecycle of the building (heating, electricity use, carpet cleaning etc.) This design practice emphasizes efficiency of heating and cooling systems; alternative energy sources such as solar hot water, appropriate building siting, reused or recycled building materials; on-site power generation - solar technology, ground source heat pumps, wind power; rainwater harvesting for gardening, washing and aquifer recharge; and on-site waste management such as green roofs that filter and control stormwater runoff. This requires close cooperation of the design team, the architects, the engineers, and the client at all project stages, from site selection, scheme formation, material selection and procurement, to project implementation.

Sustainable architects design with sustainable living in mind. Sustainable vs green design is the challenge that designs not only reflect healthy processes and uses but are powered by renewable energies and site specific resources. A test for sustainable design is — can the design function for its intended use without fossil fuel — unplugged. This challenge suggests architects and planners design solutions that can function without pollution rather than just reducing pollution. As technology progresses in architecture and design theories and as examples are built and tested, architects will soon be able to create not only passive, null-emission buildings, but rather be able to integrate the entire power system into the building design. In 2004 the 59 home housing community, the Solar Settlement, and a 60,000 sq ft (5,600 m^2) integrated retail, commercial and residential building, the Sun Ship, were completed by architect Rolf

Disch in Freiburg, Germany. The Solar Settlement is the first housing community world wide in which every home, all 59, produce a positive energy balance.

Sustainable landscape and garden design

Sustainable landscape architecture is a category of sustainable design and energy-efficient landscaping concerned with the planning and design of outdoor space. Design techniques include planting trees to shade buildings from the sun or protect them from wind, using local materials, on-site composting and chipping to reduce green waste hauling, and also may involve using drought-resistant plantings in arid areas (xeriscaping) and buying stock from local growers to avoid energy use in transportation.

Sustainable graphic design

Sustainable graphic design considers the environmental impacts of graphic design products (such as packaging, printed materials, publications, etc.) throughout a life cycle that includes: raw material; transformation; manufacturing; transportation; use; and disposal. Techniques for sustainable graphic design include: reducing the amount of materials required for production; using paper and materials made with recycled, post-consumer waste; printing with low-VOC inks; and using production and distribution methods that require the least amount of transport.

Sustainable Agriculture

Sustainable agriculture adheres to three main goals:

- environmental health,
- economic profitability,
- social and economic equity.

A variety of philosophies, policies and practices have contributed to these goals. People in many different capacities, from farmers to consumers, have shared this vision and contributed to it. Despite the diversity of people and perspectives, the following themes commonly weave through definitions of sustainable agriculture.

There are strenuous discussions — among others by the agricultural sector and authorities — if existing pesticide protocols and methods of soil conservation adequately protect topsoil and wildlife. Doubt has risen if these are sustainable, and if agrarian reforms would permit an efficient agriculture with fewer pesticides, therefore reducing the damage to the ecosystem.

For more information on the subject of sustainable agriculture: "UC Davis: Sustainable Agriculture Research and Education Program".

Domestic machinery and furniture

Automobiles, home appliances and furnitures can be designed for repair and disassembly (for recycling), and constructed from recyclable materials such as steel, aluminum and glass, and renewable materials, such as Zelfo, wood and plastics from natural feedstocks. Careful selection of materials and manufacturing processes can often create products comparable in price and performance to non-sustainable products. Even mild design efforts can greatly increase the sustainable content of manufactured items.

Improvements to heating, cooling, ventilation and water heating

- Absorption refrigerator
- Annualized geothermal solar
- Earth cooling tubes
- Geothermal heat pump
- Heat recovery ventilation
- Hot water heat recycling
- Passive cooling
- Renewable heat
- Seasonal thermal storage
- Solar air conditioning
- Solar hot water

Disposable products

Detergents, newspapers and other disposable items can be designed to decompose, in the presence of air, water and common soil organisms. The current challenge in this area is to design such items in attractive colors, at costs as low as competing items. Since most such items end up in landfills, protected from air and water, the utility of such disposable products is debated.

Eco fashion and home accessories

Creative designers and artists are perhaps the most inventive when it comes to upcycling or creating new products from old waste. A growing number of designers upcycle waste materials such as car window glass and recycled ceramics, textile offcuts from upholstery companies, and even decommissioned fire hose to make belts and bags. Whilst accessories may seem trivial when pitted against green scientific breakthroughs; the ability of fashion and retail to influence and inspire consumer behaviour should not be underestimated. Eco design may also use bi-products of industry, reducing the amount of waste being dumped in landfill, or may harness new sustainable materials or production techniques e.g. fabric made from recycled PET plastic bottles or bamboo textiles.

Energy Sector

Sustainable technology in the energy sector is based on utilizing renewable sources of energy such as solar, wind, hydro, bioenergy, geothermal, and hydrogen. Wind energy is the world's fastest growing energy source; it has been in use for centuries in Europe and more recently in the United States and other nations. Wind energy is captured through the use of wind turbines that generate and transfer electricity for utilities, homeowners and remote villages. Solar power can be harnessed through photovoltaics, concentrating solar, or solar hot water and is also a rapidly growing energy source.

The availability, potential, and feasibility of primary renewable energy resources must be analyzed early in the planning process as part of a comprehensive energy plan. The plan must justify energy demand and supply and assess the actual costs and benefits to the local, regional, and global environments. Responsible energy use is fundamental to sustainable development and a sustainable future. Energy management must balance justifiable energy demand with appropriate energy supply. The process couples energy awareness, energy conservation, and energy efficiency with the use of primary renewable energy resources.

Water Sector

Sustainable water technologies have become an important industry segment with several companies now providing important and scalable solutions to supply water in a sustainable manner.

Beyond the use of certain technologies, Sustainable Design in Water Management also consists very importantly in correct implementation of concepts. Among one of these principal concepts is the fact normally in developed countries 100% of water destined for consumption, that is not necessarily for drinking purposes, is of potable water quality. This concept of differentiating qualities of water for different purposes has been called "fit-for-purpose". This more rational use of water achieves several economies, that are not only related to water itself, but also the consumption of energy, as to achieve water of drinking quality can be extremely energy intensive for several reasons.

Related Post

ainable design

Sustainable Design

Sustainable design seeks to reduce negative impacts on the environment, and the health and comfort of building occupants, thereby improving building performance. The basic objectives of sustainability are to reduce consumption of non-renewable resources, minimize waste, and create healthy, productive environments.

Sustainable design principles include the ability to:

- optimize site potential;
- minimize non-renewable energy consumption;
- use environmentally preferable products;
- protect and conserve water;
- enhance indoor environmental quality; and
- optimize operational and maintenance practices.

Utilizing a sustainable design philosophy encourages decisions at each phase of the design process that will reduce negative impacts on the environment and the health of the occupants, without compromising the bottom line. It is an integrated, holistic approach that encourages compromise and tradeoffs. Such an integrated approach positively impacts all phases of a building's life-cycle, including design, construction, operation and decommissioning.

GSA and Sustainable Design

In January 2006, 19 federal agencies signed a Memorandum of Understanding for Federal Leadership in High Performance and Sustainable Buildings committing to "federal leadership in the design, construction, and operation of High-Performance Sustainable Buildings. Termed the "Guiding Principles," it charged agencies with implementing building design and operation strategies that provide

optimal performance and maximize life-cycle asset value. In December 2008, the Interagency Sustainability Working Group developed High Performance and Sustainable Buildings Guidance to assist agencies in meeting the high-performance and sustainable buildings goals of Executive Order 13423.

In January 2007, Executive Order 13423 - "Strengthening Federal Environmental, Energy, and Transportation Management" set numerous federal energy and environmental management requirements, including requirements for the entire GSA portfolio to:

- Reduce metered energy use by 3 percent per year
- Reduce metered energy use by 30 percent by 2015
- Reduce metered water use by 16 percent by 2015

In December of 2007, the Energy Independence and Security Act of 2007 (EISA 2007) established additional energy management goals and requirements. New GSA buildings and major renovations must reduce fossil-fuel-generated energy consumption by 55 percent by 2010 and by 100 percent by 2030.

In October 2009, Executive Order 13514 established a government-wide focus on sustainability, energy efficiency, and the environment.

GSA is committed to incorporating principles of sustainable design and energy efficiency into all of its building projects. The result is an optimal balance of cost, environmental, societal and human benefits while meeting the mission and function of the intended facility. It is GSA's intent that sustainable design will be integrated as seamlessly as possible into the existing design and construction process.

GSA and LEED

GSA uses the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED®) green building certification system as a tool for evaluating and measuring achievements in sustainable design. LEED® consists of a set of prerequisites and credits with specific requirements for obtaining points in order for a building to become LEED® certified. GSA uses LEED® to ensure that sustainable strategies are considered in the development of all GSA building projects. GSA requires, at a minimum, new construction and substantial renovation of Federally-owned facilities to be LEED® Gold.

Sustainability Matters

Sustainability Matters is a publication of case studies and best-practices that address GSA's sustainability initiatives and strategies at all stages of a building's lifecycle. Sustainability Matters is the first comprehensive overview by a federal agency related to the issues of building, operating and maintaining facilities sustainably.

Sustainable Facilities Tool

The Sustainable Facilities Tool is a one-stop online resource to support decision-making regarding sustainable building principles, materials

and systems. Targeted to help project personnel identify and prioritize cost-effective, sustainable strategies for small projects, the Sustainable Facilities Tool helps users understand and select environmentally preferable solutions for renovations, alterations and leases.

Sustainable Design

The 2030 Challenge and commitment for plumbing engineers

By Winston Huff, CPD, LEED AP BD+C

Reducing fossil fuel usage and greenhouse gas emissions are important goals for our industry; however, they are difficult to achieve and measure. Designers, contractors, owners and operators start with good intentions, but many new buildings ultimately have minimal energy-efficiency improvements over the buildings they replaced.

Buildings are major consumers of energy. To decrease greenhouse gas emissions and fossil fuel consumption, the building industry must have an energy plan. Two years ago, Architecture 2030 took a bold, proactive step and developed a challenge for those in the building profession. The 2030 Challenge sets goals with target years for reducing the use of fossil fuels in buildings. With goals and endpoints in place, the building design, construction, operations and manufacturing teams will have time to adapt and develop practices, methods and products to reach the goals.

The Challenge defines a performance standard of 60 percent below the average for the building type. At first this would seem to be a difficult task. In reality, technologies and methods are available to achieve this standard in most building types. The Challenge includes existing buildings and encourages them to be renovated.

The targets include a timeline in which buildings achieve a 70 percent performance standard in 2015. Every five years the standard increases, with the goal of being 100 percent carbon neutral by 2030. This means using no fossil fuel or other greenhouse gas-emitting energy to operate. Since this challenge was introduced, new buildings in design and in operation have met the 100 percent challenge.

High-performance buildings

A new demand for high-performance buildings has appeared as a result of this challenge and other forces in the marketplace. These buildings use less fossil fuel than other buildings of the same type. Because owners and developers are using financial models to make the buildings profitable, this trend should continue.

With this demand in the building industry comes a need for high-performance building design (HPBD) practices. Building designers are finding ways to incorporate elements with the potential to meet the operational energy goals of the building owner. Design architects and engineers are looking at new technologies, strategies, procedures and methods to help buildings have a better chance of meeting these goals.

“To reach our goal of carbon neutral buildings by 2030, there is a crucial need for design experts to apply their experience, innovations and talents to current practices that will lead to significant reductions in the use of natural resources, nonrenewable energy sources and waste production,” said former AIA executive vice president/CEO Christine McEntee in an article in Building Design + Construction.

HPBD is resulting in new methods and technologies for contractors to construct buildings. Many plumbing training programs are helping installers understand the new methods and develop procedures to ensure that high-performance features are installed and operate properly.

The new technologies in HPBD also are changing the way buildings are operated. These buildings include new systems and tools for operators, so it is important for operators to know how to keep the new technologies working to realize the improvements in energy efficiency. The best designed and equipped facility means little if the operator does not know how to keep it running to its full potential. Thus, the building operator should be included in the early schematic phase of design to give the design team direction when the energy model is being developed.

Energy modeling

In May, AIA EVP/chief executive officer Robert Ivy, FAIA, said, “Integrating energy modeling into the design process is the best way for architects to implement strategies to reduce energy consumption in their projects and educate their clients of the potential for savings on utility costs over the entire life cycle of the building.”

In the past, the energy model was created by the HVAC engineer to design the HVAC system after the building was designed. Other building team members, such as the architect or operations manager, offered little input. However, with HPBD it is important for all of the design and operating professionals, including the plumbing engineer, to be part of the whole building model.

Cooperation has the best impact in the schematic phase of a project. Adding elements after the schematic design can increase costs and frustrate the design, construction and operations teams, and such elements are at a greater risk of being eliminated from the project.

How plumbing systems can help

Energy models using the whole building concept are changing the way plumbing systems are designed because they highlight how plumbing systems contribute to a building’s energy use. For example, in buildings with food-service dishwashing demands or dormitories with extensive shower demands, a large percentage of the building’s energy usage is from plumbing and water systems. Building modeling can show how water efficiency brings energy efficiency. Reducing the flow of water in showers can reduce the energy load on both the water heater and the pumping system.

Building pumps can use large amounts of energy, so pumps with energy-efficient motors and operational controls or with variable-frequency drives are required in high-performance buildings. Accurate sizing of the pump is crucial, because oversized pumps can waste energy during the life of the building. The piping design also is important. The pumps should be located in the overall system where they provide the most efficient operation.

Water heater designs are changing as well. Condensing-type HVAC and domestic water boilers are taking over a larger percentage of the water heater market. Energy modeling is looking at water heating and space heating as one system. Because of this, plate and frame heat exchangers are now viable options in many building types. Controls are improving, and more sizing options are available. Energy modeling is showing that efficient heat pump water heaters also are a viable option.

When energy modeling is used and options are evaluated, many building owners are discovering that thermal solar-powered systems can be used to work with the space heating or the domestic water heating system. When compared to photovoltaic solar systems, solar thermal systems can generate more energy in a smaller footprint for less cost.

Now is the time for plumbing engineers to develop ways to design plumbing systems that meet or exceed the 60 percent target. Plumbing engineers should be familiar with the energy-efficient elements, technologies and strategies of other trades so they know how the plumbing system can help reduce the overall energy load of the building. They will also need to know how these systems will be installed by the contractors and operated by the building staff. They should also plan for the carbon-neutral target and should be asking important questions: are there any non-fossil fuel alternatives for plumbing systems available? And when is it more efficient to have photovoltaic solar panels and an electric water heater or to use a solar thermal water heating system? These are questions we will need to answer.

Winston Huff, CPD, LEED AP BD+C, is a project manager, plumbing fire protection designer and sustainable coordinator with Smith Seckman Reed Consulting Engineers in Nashville, Tenn. He serves as an ASPE representative on the ICC Green Construction, Energy and Water Code Development Committee and is on the

U.S. Green Building Council's Water Efficiency Technical Advisory Group. He was the founding editor of Life Support and Biosphere Science and has served as its editor-in-chief. He also is editor of Me Green You Green (megreenyougreen.com), a LEED credit databank.

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- *Green Links*
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Plumbing LEED® Points

Larry Oliver, CPD, LEED® AP, Sacramento Associate Principal

This article is to provide an overview of potential LEED® points available in a building and sustainable features focusing on the plumbing system. So what is LEED®?

The U.S. Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED®) rating system in 1998. This rating system provides a point system score card to evaluate the environmental performance from a whole building perspective (non-residential). The rating system is organized into five environmental categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality. For the purpose of our discussion we will be focusing on Water Efficiency.

The Water Efficiency category of the LEED® rating system is the least emphasized, with a potential of three LEED® points obtainable through Innovative Waste Water Technologies and Water Use Reduction. The LEED® rating system for Water Use Reduction is based on the U.S. Energy Policy Act of 1992. This Act set maximum plumbing fixture flow rates.

ENERGY POLICY ACT OF 1992

Fixture:	Maximum Flow Rate:
Water Closet	1.6 Gallons Per Flush (GPF)
Urinals	1.0 Gallons Per Flush (GPF)
Faucets	2.5 Gallons Per Minute (GPM)
Shower Heads	2.5 Gallons Per Minute (GPM)

We now have a basis to evaluate sustainable features in a non-residential building. The purpose of LEED® is to make buildings more efficient and sustainable than the maximum required levels. I will not differentiate between new or existing construction, it should be clear which features will be easiest to implement in the type of building you are evaluating or designing.

Innovative Waste Water Technologies: WE Credit 2, 1-Point

(Based on LEED®-NC Version 2.2 Reference Guide)

Intent:

To reduce generation of wastewater and potable water demand, while increasing the local aquifer recharge.

Requirements:

Option 1

Reduce potable water use for building sewage conveyance by 50% through the use of water-conserving fixtures (water closets and urinals) or non-potable water (captured rainwater, recycled graywater, and on-site or municipally treated wastewater).

OR

Option 2

Treat 50% of wastewater on-site to tertiary standards. Treated water must be filtered or used on-site.

My experience is that the collection of rainwater is a fairly straight forward method of obtaining this credit point. I recommend the collection of rainwater from the roof rather than parking lots which contain oils and other hazardous waste contaminants which are more difficult to filter and handle for disposal to be used in the plumbing system. The collection of rainwater requires the rainwater drainage system be collected and piped to a collection tank(s) (underground or above ground). The rainwater is in most cases pumped from the collection tank through a series of filters (5 micron to collect the large particles and 50 micron to collect any other solids) and then passed through a UV sterilizer to kill any bacteria. The collected rainwater is now ready to be used to flush the water closets and urinals, keep in mind this is non-potable and should be treated as such. In my designs I provide a backup connection to the potable water system in the building in the event no rainwater is available. The backup connection of potable water is protected by a reduced-pressure backflow device to protect the building potable water system

from the cross-connected reclaimed rainwater. This system is most likely to be designed in new construction, since an existing building retrofit would be cost prohibitive.

Example Case:

In this example, we will show potable water calculations for sewage flows for a non-residential building with an occupant capacity of 100 (50 males and 50 females). The calculation is based on a typical 8-hour workday. Male occupants are assumed to use water closets once and urinals twice a day. Female occupants are assumed to use water closets three times.

BASELINE CASE

Fixture Type	Daily Uses	Flowrate (GPF)	Occupants	Sewage Generation (GAL)
Water Closet (Male)	1	1.6	50	80
Water Closet (Female)	3	1.6	50	240
Urinal (Male)	2	1.0	50	100

Total Daily Volume (GAL) 420

Annual Work Days 260

TOTAL ANNUAL VOLUME (GAL) 109,200

DESIGN CASE

Fixture Type	Daily Uses	Flowrate (GPF)	Occupants	Sewage Generation (GAL)
Water Closet (Male)	1	1.2	50	60
Water Closet (Female)	3	1.2	50	180
Urinal (Male)	2	0.5	50	50

Total Daily Volume (GAL) 290

Annual Work Days 260

Annual Volume (GAL) 75,400

Rainwater Volume (GAL) (25,000)

TOTAL ANNUAL VOLUME (GAL) 50,400

The baseline case flow rates use the maximum flow rates based on the U.S. Energy Policy Act of 1992. Using a combination of water conserving fixtures and rainwater collection the design case building indicates a 54% reduction in potable water volume used for sewage conveyance; this therefore qualifies for the one point credit.

While the reduction of wastewater by use of rainwater is achievable the easier method of wastewater reduction as well as overall water use reduction is the application of water efficient fixtures. We will now look at the LEED® credit water use reduction.

Water Use Reduction: WE Credit 3.1, 1-Point

(Based on LEED®-NC Version 2.2 Reference Guide)

20% Reduction

Intent:

To maximize water efficiency within buildings to reduce the burden on municipal water supply and waste water systems.

Requirements:

Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculation based on estimated occupant usage and shall include only the following fixtures as applicable to the non-residential building: water closets, urinals, lavatory faucets, showers and kitchen sinks.

Water Use Reduction: WE Credit 3.2, 1-Point

(Based on LEED®-NC Version 2.2 Reference Guide)

30% Reduction

This credit employs the same requirements as above except 10% more efficient.

It has been my experience that water saving methods of employing water efficient fixtures is both easy and cost effective for both new and retrofit construction. My standard designs employ all the requirements to comply and achieve these LEED® credits. We can use our example above to demonstrate just how easy it is to be sustainable and water efficient at no additional cost.

BASELINE CASE

Fixture Type	Daily Uses	Flowrate (GPF)	Duration (flush)	Auto Controls (N/A)	Occupants	Water Use (GAL)
Water Closet (Male)	1	1.6	1		50	80
Water Closet (Female)	3	1.6	1		50	240
Urinal (Male)	2	1.0	1		50	100
Fixture Type	Daily Uses	Flowrate (GPM)	Duration (Sec)	Auto Controls	Occupants	Water Use (GAL)
Lavatory	3	2.5	15	No	100	188

Total Daily Volume (GAL) 608

Annual Work Days 260

TOTAL ANNUAL VOLUME (GAL) 158,080

DESIGN CASE

Fixture Type	Daily Uses	Flowrate (GPF)	Duration (flush)	Auto Controls (N/A)	Occupants	Water Use (GAL)
Water Closet (Male)	1	1.2	1		50	60
Water Closet (Female)	3	1.2	1		50	180
Urinal (Male)	2	0.5	1		50	50
Fixture Type	Daily Uses	Flowrate (GPM)	Duration (Sec)	Auto Controls	Occupants	Water Use (GAL)
Lavatory	3	0.5	10	Yes	100	25

Total Daily Volume (GAL) 315

Annual Work Days 260

TOTAL ANNUAL VOLUME (GAL) 81,900

The baseline case flow rates use the maximum flow rates based on the U.S. Energy Policy Act of 1992. Using a combination of water conserving fixtures the design case building indicates a 48% reduction in potable water volume; this therefore qualifies for the one point credit for the 20% reduction plus an addition one point for exceeding the 30% water use reduction for a total of two LEED® points. What makes this so simple is the fact standard fixtures are available from all the major fixture manufacturers to meet these criteria. If we only used a 0.5 GPF urinal and water saving metering faucets on the lavatories we would still realize a 35% water reduction without changing the water closets.

The LEED® point system also allows for **Innovative & Design Process** points (maximum of 4). These allow the designer to submit to the USGBC an innovative design concept that might not be covered within the existing point structure, such as Press-Fit copper piping or CSST gas piping. These systems may qualify for an innovative credit point because they use recyclable materials and are solder-less and oil-less which is environmental friendly.

Hopefully you see that providing a sustainable plumbing design to obtain LEED® related points is fairly easy when thoughtful choices are made, in fact you may already be designing to meet these requirements. Although I discussed non-residential buildings all of these measures can be applied to residential as well.

Sustainability

Sustainability is no longer just a buzz word, it is rapidly becoming a way of life. Simply stated, our actions today can dramatically affect the future. The design and construction industry is undergoing a transformation, incorporating sustainability into a diverse range of projects. C&S implements sustainable designs and construction processes in a manner that can greatly improve energy efficiency and reduce the burden on the environment while improving the health, well being, and productivity of the end users. When experienced design professionals incorporate sustainable philosophies early in a project, the initial cost can be kept in balance, and substantial savings over the life of the project can be realized.

Our philosophy is based on the concept of the triple-bottom line of people, planet, and profit, where each element must be balanced in order to achieve success. This results in more well-rounded projects that consider a wide range of impacts from the outset. By having all members of a project design and construction team collaborate early on in the process, we can develop solutions that save money, reduce environmental impacts, and give end users a more functional product. We know that sustainable projects don't have to cost more. In fact, they often cost less to build and almost always cost less to maintain and operate over the long term.

C&S can help you understand opportunities and alternatives for providing energy-efficient and environmentally responsible sustainable designs and construction. Our LEED accredited professionals and certified energy managers represent all design disciplines, including architectural, structural, mechanical, electrical, plumbing, site/civil, environmental, and construction. Our team has been involved in the design, commissioning, construction management and LEED certification on sustainable projects for higher education, schools, commercial facilities, and institutional projects. C&S is also a member of the U.S. Green Building Council. Whether your goal is the incorporation of sustainable design or formal LEED certification of your projects, C&S's experienced professionals will guide you toward solutions that align with your values, goals, and budget, helping to give the future generations the ability to meet their needs. C&S has been involved in dozens of LEED certified projects and hundreds of

projects that incorporated sustainable design elements. Our goal is to help clients understand how sustainability makes sense financially, environmentally, and socially.

- Sustainability planning
- Building design and retrofitting
- Site design
- Landscape architecture
- Building performance modeling
- Energy efficiency and commissioning
- Environmental
- LEED administration services

LEED and Sustainable Design and Construction

When it comes to sustainable, energy-efficient plumbing, Modern Plumbing Industries, Inc. (MPI) has the knowledge and experience for any "green" plumbing project. Our estimation and construction teams have worked on countless LEED Certified projects keep up to date with the latest information on government sustainability programs, incentives, and green living rebates.

Our Sustainability Project Success

We recently assisted the University of Central Florida (UCF) Burnett School of Biomedical Sciences in achieving LEED Silver status. In addition, our work at Hensel Phelps' Southeast District Office helped them achieve LEED Gold certification.

Our knowledge extends to the following systems:

- Greywater systems
- Reclaimed water systems
- Rainwater harvesting system
- Cisterns
- Solar hot water heating

Even if a client is not interested in LEED certification, a cost benefit analysis (CBA) can be provided to show future returns on a "green" plumbing investment

Take a look at this recent installation of a 30 panel array for solar hot water heating system we installed in the University of Central Florida (UCF) Tower 2 dormitory, which lowered energy costs according to data collected by the University.

Commercial Solar Water Heaters

MPI offers some of the best commercial solar water heaters on the market. Our commercial plumbers are trained to install and maintain solar water heaters of all makes, models, and sizes. We make sure to keep up with the latest advancements in solar technology, and we will work with you to help you choose the most cost-efficient model for your business. Taking advantage of solar technology will include a lot of considerations, such as your business's water usage needs, but in some cases, solar water heaters have been known to lower energy costs as much as 80%.

Low Flow Faucets & Plumbing Fixtures

Installing low flow faucets and fixtures are another way to lower your overall utility bills and become a greener company. When you reduce the flow rate and save water, you're also reducing the cost of heating the water in your place of business. MPI offers a wide variety of low flow plumbing fixtures for any commercial or industrial space. Our expert plumbers will work with you to figure out what system is best for your business.

Energy Savings Consultations

Modern Plumbing also can provide consultation on a number of energy-efficient plumbing fixtures, including:

- Dual flush water closets
- Low flow fixtures
- Waterless urinals

Working with Orlando's Hyatt Regency Grand Cypress , Modern Plumbing Industries retrofit the hotel's 814 rooms with low-flow plumbing fixtures, working a rigorous schedule to provide service without disruption to the hotel's guests.

Going Green with MPI

MPI can help your Orlando metropolitan area business grow using the most environmentally sustainable practices. We offer some of the best energy-saving plumbing equipment on the market, and our technicians are highly knowledgeable about all aspects of green plumbing technology. Go green and call today!

Sustainable Design, Energy Conservation

MK2 believes that sustainability is economic benefit through energy conservation achieved by practicing a triple bottom line philosophy in our design: Planet, People, and Performance.

Leadership in Energy and Environmental Design (LEED)
MK2 has an extensive track record of using sustainable energy efficient applications for our institutional, commercial, and residential clients to save energy and consistently lower monthly energy bills for utilities as well as lower maintenance costs long before the recently established LEED Certification System. We are continually adding LEED Accredited Professionals to our staff and Consultant Team. Currently MK2 has three (3) LEED Accredited Professionals on staff. MK2 provides unique sustainable concepts to maximize profitability in building system upgrades by practicing an integrated design approach between our Mechanical, Electrical, Plumbing, Fire Protection, and Sustainability Staff.

LEED Targeted Certifications
We currently have several projects that are applying for LEED Certification Rating.

- Napa Square: A retail and office facility
  - LEED for New Construction: Silver Rating
- Prison Industry Authority: Folsom Office Building
  - LEED for New Construction: Silver Rating
- Napa County Sheriff Facility
  - LEED for New Construction: Silver Rating
- Los Gatos, California; Single Family Residence

- LEED for Homes: Silver Rating

LEED Certification Services
MK2 conducts the LEED Certification Process for Building Owners who want the design and construction of their projects to receive the LEED Certification. MK2 works with your design team to allocate the systems and procedures and manage the documentation and monitoring process that is required by the U.S. Green Building Council to achieve the LEED Certification. Our project management technique for LEED Certification emphasizes the use of Eco-Charrettes to address

Plumbing, Renewable Energy, Sustainable Heating and Water Saving Solutions

CLK was established in 2004 by Simon Crotty. The aim was to provide a high level of craftsmanship, knowledge and reliability in plumbing, heating and renewable energy installations at a competitive price to all. The basic but essential thinking has seen CLK continue to grow into a company which expects our customers to demand competency and quality. Today, at CLK, we are continuously evolving and re-educating ourselves to meet the requirements and standards of a new sustainable future.

Sustainable design for plumbing engineers: here's a review of what a plumbing engineer/designer needs to know to successfully implement and promote a sustainable plumbing design.

Magazine

PM Engineer
July 1, 2005 | Ham, Paul L. | Copyright

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As our industry changes and grows with the 21st century, it is the responsibility of every member of a design and construction team to embrace and promote new technologies, methodologies, and most of all, paradigms. A paradigm is

defined by Webster's dictionary as "a philosophical and theoretical framework of any kind." One such philosophical framework that is quickly gaining momentum in this industry is sustainable design.

[ILLUSTRATION OMITTED]

Sustainability in our industry can be defined as the design, construction and ongoing operation of environmentally responsible, healthy and efficient building. As the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) Green Building Rating System[R] is currently one of the more popular frameworks by which sustainability is measured, this article will focus specifically on what LEED[R] plumbing-related credits and requirements are needed to implement and promote a sustainable design.

The plumbing designer is involved in up to 10 points within the 69 point LEED Building Rating System. This translates to roughly 15% of the possible points, while a building's plumbing systems typically cost 2-3% of the overall construction cost. As can be seen by these figures, the USGBC has placed a great deal of importance on plumbing within sustainable design.

Overview

The most important aspect of sustainability that the plumbing designer must understand is the concept of integration. Because plumbing design decisions can have both positive and negative impact on non-plumbing aspects of the overall design it is imperative that the plumbing designer be an active member of the team as early in the process as possible. Initially this will assist the plumbing designer in understanding and embracing the project's initial sustainable goals and objectives. Equally important, this early involvement will promote effective communication with all members of the design and construction team.

NSG Plumbing recognises the value add benefits realised by adopting and implementing sustainable solutions for Commercial Developments and Building Maintenance projects.

We offer advice, installation and maintenance for the following sustainable systems:

- Rain water harvesting
- Black water treatment

- Hot water generation
- Sustainable audits
- 5 star / green star hydraulic plumbing systems

Hot Water Generation Plant

- 5 star hot water plant
- Multiple heat source options for gas, solar and mechanical services return air
- Reduced gas consumption.

Five Star Energy Rating

NSG Plumbing has expertise in delivering energy efficient hot water generation systems for commercial, industrial and domestic projects.

We are the Victorian distributor for Rotex Australia offering a range of products which deliver cost savings through innovative design quality and durability. We can tailor a package to meet your specific energy saving requirements.

Contact us for information about the latest sustainable solutions available and how they can benefit your next project.

You might also like:

Accessibility and Restrooms

Snow and Ice Management: Safety Tips

Wayfinding Systems

Maximize Daylight with High Reflectance Ceilings

Carpet Reclamation Costs

Plumbing & Restrooms

I'm Dan Hounsell, editor of Maintenance Solutions magazine. Today's topic is plumbing systems and sustainability.

Before taking on renovations or large-scale retrofits to improve water-use efficiency, maintenance and engineering managers should identify an approach for the project that will help them achieve the organization's sustainability goals. Properly specified, restroom faucets can help managers and their organizations achieve these goals.

Managers typically specify restroom faucets for three broad applications.

The first category is hand washing in public restrooms. Most codes require the fixtures use 0.5 gallons per minute (gpm). The Leadership in Energy and Environmental Design (LEED) rating system requires these fixtures for public toilets.

The second category is for private fixtures occupants use for moderate hand washing and light bathing — face washing, shaving, or teeth brushing. Codes usually refer to these facilities as private lavatories. Common applications in this category are dormitories, gyms, locker rooms and workout areas. These fixtures also are appropriate for clinical areas, where workers must wash their hands regularly. For such applications, managers should not specify faucets that use more than 1.8 gpm.

The third category involves private fixtures occupants use for heavier hand washing, such as medical, culinary, and maintenance. These applications require more water. As a result, managers can specify 1.8-2.2 gpm fixtures. Most codes limit these fixtures to less than 2.2 gpm.

Finally, in some applications, users might have to actively clean and scrub their hands for a predetermined amount of time. In most cases, the water does not have to remain flowing during scrubbing. In situations such as this, managers can specify sensor-, foot-, or knee-operated fixtures.

RELATED CONTENT:

Plumbing , green , renovations

able site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

There are four levels of LEED certifi-cation with 69 possible points. A certi-fied building must have a minimum of 26 points. A silver rating is 33 points; gold is 39 points; and platinum is 52 points.
A sustainable building’s economic benefits include the returns from a company’s most expensive cost: its employees. Office workers often are dissatisfied with temperature, indoor air quality, acoustics, and lighting; thus, productivity suffers. For example, the West Bend Mutual Insurance Co. documented a 16 percent productivity gain in the early 1990s due to its new 150,000-square-foot green building, which incorporates daylighting, individ-ually controlled workstations, connec-tivity to

nature, and improved lighting. With an annual payroll of $13 million at that time, the increase was worth more than $2 million each year. Energy costs also were reduced by an estimated 40 percent.
Buildings with healthy indoor envi-ronments also are easier to lease and have a higher resale value because a greater percentage of the buildings is occupied.
Once a building owner and the design team have decided to work toward LEED certification, the first step is to register the project with the USGBC. Refer to the USGBC Web site (www.usgbc.org) for complete details on the process. Registration requires submitting detailed building informa-tion, as well as paying a fee. This also is the time to purchase copies of the rating systems. (See sidebar "LEED Products" for a brief overview of cur-rent and soon-to-be-released rating systems.)
After registering, the team gains access to different sections of the USGBC's Web site and receives LEED templates and online project listings. This year an online electronic submis-sion process will be available.
The design and construction team now should start reviewing the rating systems to determine which points they can obtain for their project. Each point requires submission of drawings, letters, or calculations to the USGBC. The Credit Inquiries and Rulings (CIR) section of the USGBC Web site—to which you receive access after register-ing—can help clarify some frequently asked questions.
The team should collect the required data during the design and construc-tion process, which can last months or longer. When the drawings, letters, calculations, and material cutsheets are ready, the team can submit them to the USGBC for review. After the review process is complete, the building receives a certification. It is important to remember the LEED certification is not a simple process; it requires a commit-ted effort by the entire design and con-struction team throughout the building's development.
Major LEED Points for Plumbing Systems
LEED points are awarded for plumb-ing building materials, construction methods, plumbing equipment energy efficiency, sanitary sewer systems, storm water systems, and potable water systems. Points that involve plumbing systems are obtained by using water-reducing plumbing fixtures and materi-als made with recycled content, harvest-ing storm water, and reducing potable water usage.
Green Roofs. One of the first points that applies to the plumbing system design is Sustainable Sites Credit 6.1, which requires, "No net increase in the rate and quantity of storm water runoff from existing to developed conditions; OR, if existing imperviousness is greater than 50%, implement a storm water management plan that results in a 25% decrease in the rate and quantity of storm water runoff," according to the LEED Reference Guide Version 2.0.
The installation of a green roof can help in obtaining this credit. To under-stand why, it is important to understand the intent of a green roof in a sustain-able building.
The USGBC currently is addressing one of urban sprawl's most negative effects: the replacement of green spaces with hard surfaces such as roofs and parking lots. On a large scale, impervi-ous surfaces can cause flooding that contaminates streams and rivers. In some areas, combined sanitary and storm sewer systems are too small to handle heavy rains, which causes raw sanitary sewage to be dumped into rivers and streams.
A sustainable building with a green roof reduces the amount of impervious surfaces, such as roofs, in a project. Another advantage of a green roof is that it can help reduce the amount of storm water that leaves the building site. The use of a green

roof along with open grass areas on a site can increase a site's pervious rate and, as a result, reduce the project's effect on the exist-ing storm water system.
Irrigation Reduction. Plumbing engineers also can design landscaping systems that obtain Water Efficiency credits. One point is available from WE Credit 1.1: "Use high efficiency irrigation technology, OR, use captured rain or recycled site water to reduce potable water consumption for irriga-tion by 50% over conventional means." Another point is available in WE Credit 1.2: "Use only captured rain or recycled site water for an additional 50% reduc-tion (100% total reduction) of potable water for site irrigation needs, OR, do not install permanent landscape irriga-tion systems." The sustainable goals for these points are to reduce or eliminate potable water use in the irrigation system.
The installation of an irrigation moni-toring system that operates on timers or sensors in the ground and only waters the landscaping in dry conditions can help in obtaining this point. Other ways include using indigenous or drought-resistant plants that do not require watering and collecting storm water in tanks for use in irrigation.
Waterless Urinals. WE Credit 3.1 offers one point when you "Employ strategies that in aggregate use 20%

How Do Buildings A.ect the Environment?
• Buildings use 62.2 percent of total U.S. electricity consumption.
• Buildings comprise more than 36 percent of total U.S. primary energy users.
• Buildings produce 30 percent of total U.S. greenhouse gas emissions.
• 136 million tons of construction and demolition waste are generated in the United States per year (approximately 2.8 pounds per person per day).
• Buildings use 12 percent of the pota-ble water in the United States.
Sources: U.S. Department of Energy, U.S. Environmental Protection Agency, U.S. Geological Service, Worldwatch Institute

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