UCSC GBC Research Appendix

Purpose: The Green Building Checklist will be a tool to assist project managers in better incorporating more energy and water-efficient design in the pre-design, preliminary planning, working drawings, construction and commissioning phases of project development.

Vision: The final product will be a detailed checklist that includes the following features;

1. Living tool with web-based interface
2. Tailored to tiered project types
3. Step-by-step roadmap including instructions for use, links to forms, contact information, and other pertinent supporting resources

Project Cost Categories:

1) Deferred Maintenance** and Maintenance Projects
2) $35,000 - $750,000 (Minor Capital Projects*)
3) > $750,000 (Major Capital Projects*)
    - < $5million - Chancellor approval/signature required
    - > $5million - UC Office of the President approval/signature required
    - > $10million - Regents approval/signature required

*Capital Improvement Projects are those that add new space or infrastructure, or alter the programmed design or function of existing space, building systems, or infrastructure.

**Deferred maintenance projects include maintenance, repair, or replacement projects that continue the usability of a facility at its designed level of service. Repair, maintenance, and replacement projects typically only involve Physical Plant.

User Types:

- Physical Planning & Construction staff (Project Managers)
- Physical Plant staff (Project Managers)
- CPSM
- Building Coordinators/Facility Managers

Project Phases:

1. Pre-Design
    - **a.** Program Planning Guide
        - i. Capital Planning & Space Management & PPC PM
    - **b.** Program Design Document
2. Procurement (RFQ, consultant selection, contract execution)

    a. Usually an EDPA, sometimes a PSA
3. Preliminary plans
4. Schematic Design
5. Design Development
6. Working Drawings (I.E. construction drawings)
7. Construction
8. Commissioning

Procurement: Include the following language in the RFP/RFQ:

- The project will meet aggressive whole building energy performance targets. Targets are set at 50% of a business-as-usual benchmark representing average energy performance for equivalent facilities circa 2000. See [link] for additional detail.
- Design teams must demonstrate compliance with targets through energy models that estimate as-operated energy use performance (not code compliance).
- Describe experience with the use of energy models that estimate as-operated energy use performance.

Start a Capital Project:

If your project falls within the first 3 categories* complete the form available at http://ppc.ucsc.edu/Startproject/index.html

*If your project is over $35,000, Capital Planning and Space Management (CPSM) will assign a Planner to your project to the lead during the initial programming, scoping, and budgeting phase, with support from PPC. CPSM also helps campus departments navigate the approval and funding process. Once the scope and budget are established, the two offices switch roles and PPC takes the lead with support from CPSM as a project proceeds through the design and construction phases.

Project Type:

A. Energy
B. Water

Renovation

office

lab
classroom
Housing

Renovation
HVAC
Lighting

Project Type Subcategories:

a. Materials and resources
b. Indoor Environmental Quality
c. On-site waste reduction

Project Steps:

1) Pre-design (Studies, Master planning) PSA
2) Preliminary plans (Schematic Design, design development) EDPA
3) Working Drawings (Working drawings, construction drawings)
4) Construction
5) Commissioning

1 - Pre-Design

- Organize a design charrette with the Integrated Project Team to discuss the overall scope of the proposed project. The Integrated Project Team should include members from:
    - Interest group
    - PP&C engineers
    - Physical Plant
    - Consultant*
    - Project Manager
    - Sustainability Team (members from the Sustainability Office or Green Building Student Group)

*If the overall project budget is greater than $640,000 an outside project consultant is required.

- Create a Request For Qualifications/Request For Proposal (RFQ/RFP) outlining the project scope and requirements.
    - RFQ/RFP hiring considerations
        - Require consultant to comply with UCSC green building roadmap
        - Consultant must have experience with sustainable projects or must be willing to comply with sustainability measures on campus

- Assess the buildings main occupants operations.
    - Usage/Activities
    - Hours occupation
    - Number of occupants
    - Special requests
- Identify all of the systems that are being modified throughout the course of the project. Discuss efficiency and synergy opportunities between systems.
    - Energy related systems
        - HVAC
        - Lighting
        - Building Management Systems (BMS)
        - Domestic hot water use
        - Building envelope
        - Solar opportunities
    - Water Related Systems
        - Water use equipment
        - Fixtures
        - Irrigation
        - Storm water (capture, runoff, permeable surfaces)
- All modified systems must meet minimum efficiency levels
    - Energy Systems
        - What projects require energy modeling?
        - Required to beat 2000 level energy usage by X%
        - https://www.dropbox.com/s/ip7pq5h3v0nsnfr/Whole-Building%20Energy%20Performance%20Targets%20for%20UC%20Buildings-2.pdf?dl=0
    - Water Systems
        - Indoor water use reduction must comply with the items in Figure 1.
        -
- Compliance with California State Building Code (Title 24)

UCOP SUSTAINABILITY POLICIES

Online references

- http://ucop.edu/sustainability/index.html
- http://ucop.edu/sustainability/policies-reports/index.html

New Buildings

1. All new building projects, other than acute care facilities, shall be designed, constructed, and commissioned to outperform the CBC energy-efficiency standards by at least 20%. The University will strive to design, construct, and commission buildings that outperform CBC energy efficiency standards by 30% or more, whenever possible within the constraints of program needs and standard budget parameters.
    a. All new buildings and complete renovations (as defined in III.A.6) will register with the Savings By Design program in order to document compliance with the requirement to outperform CBC energy efficiency standards by at least 20%.
2. Standards for energy efficiency for acute care facilities will be developed in consultation with campuses and medical centers.
3. All new buildings (except acute care facilities) will achieve a USGBC LEED "Silver" certification at a minimum. All new buildings (except acute care facilities)will strive to achieve certification at a USGBC LEED "Gold" rating or higher, whenever possible within the constraints of program needs and standard budget parameters.
    a. Projects will utilize the versions of the CBC energy efficiency standards and of LEED-NC that are in effect at the time of first submittal of "Preliminary Plans" (design development drawings and outline specifications) as defined in the State Administrative Manual.[7]
4. The University of California will design, construct, and commission new laboratory buildings to achieve a minimum of LEED- "Silver" certification as well as meeting at least the prerequisites of the Laboratories for the 21st Century (Labs21) Environmental Performance Criteria (EPC)[2]. Laboratory spaces in new buildings also shall meet at least the prerequisites of Labs21 EPC. Design,

construction, and commissioning processes shall strive to optimize the energy efficiency of systems not addressed by the CBC energy efficiency standards

5. All new building projects will achieve at least two points within the available credits in LEED-NC's Water Efficiency category.

Building Renovations

1. At budget approval, all renovation projects should include a listing of sustainable measures under consideration.
2. For all improvement projects in spaces leased or licensed by the Regents to be used for University-related purposes for a term of greater than 12 months, locations shall strive to comply with the Policy requirements in III.A.6 and III.A.7, as appropriate.
    a. Renovation of buildings that require 100% replacement of mechanical, electrical and plumbing systems and replacement of over 50% of all non-shell areas (interior walls, doors, floor coverings and ceiling systems) shall at a minimum comply with III.A.3 or III.A.4, above. Such projects shall outperform CBC Title 24, Part 6, currently in effect, by 20%.

    b. Renovation projects with a project cost of $5 million or greater (CCCI 5000) that do not fall under item III.A.6. shall at a minimum achieve a LEED-CI Certified rating and register with the utilities' Savings by Design program, if eligible.

The University will use energy efficiency retrofit projects to reduce system-wide growth-adjusted energy consumption by 10% or more by 2014 from the year 2000 base consumption level.

The University planning and design process will include explicit consideration of lifecycle cost along with other factors in the project planning and design process, recognizing the importance of long-term operations and maintenance in the performance of University facilities.

For product categories where ENERGY STAR®-rated or WaterSense® certified products are available, the University will focus its procurement efforts only on products with an ENERGY STAR® rating or WaterSense® certification, consistent with the needs of University researchers, faculty, and staff.

Describes the applicable types of water comprising water systems, including but not limited to potable water, non-potable water, industrial water, sterilized water, reclaimed water, stormwater, and wastewater

Identify the building's energy use intensity using the table located here. (hotlink)
List the building's target energy use intensity based on the UCOP Sustainable Practices Policy Energy Benchmarks listed here.
Calculate the variance between the current EUI and target EUI.
If the variance is greater than X%, an energy audit of the project boundary is required.
Contact Physical Plant, Energy Services Unit to schedule an audit.

UCOP Green Building Policy edits - Whole Building Energy Performance Targets

- Meet the Whole-Building energy performance targets listed in Table 1.
- Beginning January 1, 2017, all new building projects will only be able to use energy performance targets as a compliance mechanism for energy efficiency

2. Projects opting to use energy performance targets for compliance with III.A.1 will at a minimum use the energy performance target that is listed in Table 1 and corresponds to the year of the project's budget approval.

Table 1: Whole-Building Energy Performance Targets as a Percent of 1999/2000 Benchmark Building Energy Use as published in Sahai, et al. 2014.3

Year	Compliance Target	Stretch Target
2015	65%	50%
2017	60%	45%
2019	55%	40%
2021	50%	35%
2023	45%	30%
2025	40%	25%

All projects choosing this compliance path shall provide the total building energy use intensity (in kBTU/sf/year) result from the whole-building energy model to demonstrate compliance.

Projects are also required to report on the following metrics:
- annual electricity consumption (kWh/gsf/yr)
- annual thermal consumption (therms/gsf/yr)
- peak electricity (W/gsf)

- peak chilled water (tons/kgsf) (if applicable)
- peak thermal (therms/hr/kgsf)

The following very high-intensity process loads may be subtracted out of the total building energy use intensity if they can be metered separately.

- Clean room
- Data center
- Micro-chip fabrication
- Accelerator (laser, light source)
- Biosafety Level 3 laboratory

Whole Building Energy Performance Targets for UC buildings

UCOP is proposing a complementary method of designing for energy efficiency using benchmark-based, whole-building energy performance targets.

Advantages to energy performance targets
-- static baseline (to allow for comparison of buildings over time),
-- the ability to capture energy use and efficiency for all building energy loads (not just the loads regulated by code),
--the ability to carry design targets through to operations.
--benchmarks available for UC campuses provide targets that address peak demand.

The targets are expressed as a percent of a baseline and cover all critical design parameters including annual and peak electric and natural gas use, as well as peak chilled water loads

The baselines reflect the 1999 benchmark energy performance of existing building stock for similar buildings, corrected for local climate.

CBC changes overtime and through outperforming it by a percentage is challeneging. setting static baselines allows for the buildings to increase the percentage it outperforms without confusion.

As new energy efficiency technologies and approaches become available, the target for new buildings can be moved as appropriate to continue making progress toward zero-net energy buildings. The baseline will stay the same, however, allowing for easy evaluation of energy efficiency across buildings and over time.

III. Development of Benchmarks
The 1999 UC/CSU building energy benchmarks were developed using whole-campus energy use and floor area data from eight UC and CSU campuses (UC Berkeley, UC Davis, UC Irvine, UC Riverside, UC San Diego, UC Santa Barbara, CSU Fresno, CSU Stanislaus), including both annual use/output and peak observed use/output. This utility and space data was combined with corresponding data on the wide range of combinations of district heating and cooling, heating and cooling plants, cogeneration,

and thermal energy storage systems to create a consistent data set of energy loads per unit floor area from buildings, independent of campus energy infrastructure.

The following notes apply to use of the benchmarks:
1) All heating loads are served by gas (e.g. there is no electric resistance or heat pump heating in the building). Heating loads are typically associated with natural gas use, with boilers in buildings considered equivalent to district hot water systems. For district steam systems, extra losses need to be considered for steam distribution and energy conversion to hot water within the buildings.

2) All cooling loads are served by electricity (e.g. there are no absorption or steam-turbine driven chillers in the building). Annual energy use for cooling is typically associated with electricity use, either with chillers in the building or with a district chilled water system. However, if the building is served by a district chilled water system, peak demand is separated out as a chilled water load.

UCOP has applied the same method to develop benchmark-based baselines and targets for all UC campuses.

Table 1: UC Building 1999 Energy Benchmarks by Campus – Baseline for Targets

	Annual Electricity kWh/gsf/yr Includes prorated part of plant use and site lighting	Maximum Power W/gsf Includes prorated part of small peak (pumping) load at plant	Max. Chilled Water tons/kgsf Load on plant	Annual Thermal therms/gsf/yr Includes prorated part of plant use	Max. Thermal therms/hr/kgsf Includes prorated part of plant use
Academic/Administrative Non-complex Space					
Berkeley	11.2	3.1	N/A	0.21	0.12
Davis	13.3	3.3	2.5	0.20	0.12
Irvine	13.0	2.6	1.93	0.16	0.12
Los Angeles	12.3	2.3	1.72	0.17	0.12
Merced	14.3	3.5	2.6	0.20	0.12
Riverside	13.9	3.3	2.5	0.18	0.12
San Diego	12.2	2.2	1.66	0.16	0.12
San Francisco Parnassus	11.1	2.0	1.51	0.21	0.12
San Francisco Mission Bay	11.4	3.1	N/A	0.21	0.12
Santa Barbara	11.5	2.2	1.66	0.19	0.12
Santa Cruz	11.1	3.2	N/A	0.23	0.12
Housing Non-complex					
Berkeley	7.8	2.1	N/A	0.30	0.18
Davis	9.3	2.3	1.75	0.29	0.18
Irvine	9.1	1.79	1.35	0.23	0.18
Los Angeles	8.6	1.60	1.20	0.24	0.18
Merced	10.0	2.4	1.82	0.28	0.18
Riverside	9.7	2.3	1.75	0.26	0.18
San Diego	8.6	1.55	1.17	0.23	0.18
San Francisco Parnassus	7.8	1.40	1.06	0.30	0.18
San Francisco Mission Bay	8.0	2.1	N/A	0.30	0.18
Santa Barbara	8.0	1.55	1.17	0.28	0.18
Santa Cruz	7.8	2.2	N/A	0.32	0.18
Lab/Complex Space					
Berkeley	36	7.6	N/A	1.83	0.43
Davis	38	6.3	4.7	1.83	0.43
Irvine	38	5.6	4.2	1.78	0.43
Los Angeles	37	5.4	4.1	1.79	0.43
Merced	39	6.4	4.8	1.82	0.43
Riverside	38	6.3	4.7	1.80	0.43
San Diego	37	5.3	4.0	1.78	0.43
San Francisco Parnassus	36	5.2	3.9	1.84	0.43
San Francisco Mission Bay	36	7.6	N/A	1.84	0.43
Santa Barbara	36	5.3	4.0	1.81	0.43
Santa Cruz	36	7.6	N/A	1.85	0.43
Building-Specific Adjustments					
Unique situations such as Santa Cruz's district condenser water system and Berkeley's interconnected building chillers and absorption chillers may require custom adjustments.	Annual chilled water use is typically associated with electricity use and is included in this value.	For campuses with district chilled water (e.g. Davis), if a specific building has a chiller instead, multiply value by (1/0.7) or 1.43 to account for the chiller's electric load.	Only applicable if building supplied by district chilled water system.	These values are directly applicable to buildings with boilers in the building or connected to (low-loss) district hot water systems (non-steam). They can be applicable to buildings connected to district steam systems if additional losses characteristic of steam systems is accounted for where appropriate. For example, 30% extra use from trap/exchanger losses within the building plus 30% extra use from trap/leakage losses in distribution systems has been commonly observed.	
	These values may be slightly lower than previously published values (i.e. for UC Merced) because they reflect load on the building meter (480 V) instead of at the campus meter (12 kV). To reflect load on campus meter, increase value by 1.05 (to account for distribution and transformation losses).				

Table 2: UC Building Energy-Performance Targets by Campus

	Annual Electricity kWh/gsf/yr Includes prorated part of plant use and site lighting	Maximum Power W/gsf Includes prorated part of small peak (pumping) load at plant	Max. Chilled Water tons/kgsf Load on plant	Annual Thermal therms/gsf/yr Includes prorated part of plant use	Max. Thermal therms/yr/kgsf Includes prorated part of plant use
Academic/Administrative Non-complex Space					
Berkeley	5.6	1.53	N/A	0.10	0.10
Davis	6.7	1.66	1.25	0.10	0.10
Irvine	6.5	1.28	0.96	0.081	0.10
Los Angeles	6.2	1.14	0.86	0.085	0.10
Merced	7.2	1.73	1.30	0.10	0.10
Riverside	6.9	1.66	1.25	0.090	0.10
San Diego	6.1	1.11	0.83	0.080	0.10
San Francisco Parnassus	5.6	1.00	0.75	0.11	0.10
San Francisco Mission Bay	5.7	1.53	N/A	0.11	0.10
Santa Barbara	5.7	1.11	0.83	0.10	0.10
Santa Cruz	5.6	1.58	N/A	0.11	0.10
Housing Non-complex					
Berkeley	3.9	1.07	N/A	0.15	0.14
Davis	4.7	1.16	0.88	0.15	0.14
Irvine	4.5	0.90	0.67	0.12	0.14
Los Angeles	4.3	0.80	0.60	0.12	0.14
Merced	5.0	1.21	0.91	0.14	0.14
Riverside	4.9	1.16	0.88	0.13	0.14
San Diego	4.3	0.77	0.58	0.11	0.14
San Francisco Parnassus	3.9	0.70	0.53	0.15	0.14
San Francisco Mission Bay	4.0	1.07	N/A	0.15	0.14
Santa Barbara	4.0	0.77	0.58	0.14	0.14
Santa Cruz	3.9	1.11	N/A	0.16	0.14
Lab/Complex Space					
Berkeley	18.0	3.8	N/A	0.92	0.34
Davis	18.9	3.1	2.4	0.91	0.34
Irvine	18.8	2.8	2.1	0.89	0.34
Los Angeles	18.5	2.7	2.0	0.89	0.34
Merced	19.3	3.2	2.4	0.91	0.34
Riverside	19.1	3.1	2.4	0.90	0.34
San Diego	18.4	2.7	2.0	0.90	0.34
San Francisco Parnassus	18.0	2.6	1.94	0.92	0.34
San Francisco Mission Bay	18.1	3.8	N/A	0.92	0.34
Santa Barbara	18.1	2.7	2.0	0.91	0.34
Santa Cruz	18.0	3.8	N/A	0.93	0.34
Building-Specific Adjustments					
Unique situations such as Santa Cruz's district condenser water system and Berkeley's interconnected building chillers and absorption chillers may require custom adjustments.	Annual chilled water use is typically associated with electricity use and is included in this value.	For campuses with district chilled water (e.g. Davis), if a specific building has a chiller instead, multiply value by (1/0.7) or 1.43 to account for the chiller's electric load.	Only applicable if building supplied by district chilled water system.	These values are directly applicable to buildings with boilers in the building or connected to (low-loss) district hot water systems (non-steam). They can be applicable to buildings connected to district steam systems if additional losses characteristic of steam systems is accounted for where appropriate. For example, 30% extra use from trap/exchanger losses within the building plus 30% extra use from trap/leakage losses in distribution systems has been commonly observed.	
	These values may be slightly lower than previously published values (i.e. for UC Merced) because they reflect load on the building meter (480 V) instead of at the campus meter (12 kV). To reflect load on campus meter, increase value by 1.05 (to account for distribution and transformation losses).				

Whole Building Performance Targets Before the Project Begins

By: John Elliot

Sustainable Berkeley Lab
jdelliott@lbl.gov
510-486-7188
sbl.lbl.gov

Pre-Project Phases

- Not addressed here
  - Program Design Documents
  - Design Guidelines, master specs
  - Physical Design Framework
  - Long Range Development Plan
- RFQ and RFP for a Design Team (or DBE)
- Design Team selection
- Contracting

RFQ & RFP

- Be clear
  - Signal the marketplace to attract the right team and influence team structure
- Be Brief
  - You may only get one or two sentences in an RFQ
- Think ahead
  - You can't consider something if it is not within the stated project approach and evaluation criteria
- Prioritize finding experience with:
  - High performance design
  - Modeling as-operated performance
  - Incorporating as-operated performance feedback to design

Simple RFP Language

- "The project will meet aggressive whole building energy performance targets. Targets are set at 50% of a business-as-usual benchmark representing average energy performance for equivalent facilities circa 2000"
- Design teams must demonstrate compliance with targets through energy models that estimate as operated energy use performance (not code compliance).
- Describe experience with the use of energy models that estimate as-operated energy use performance.

Design Team or DBE Selection

- Make sure that someone who understands WBPTs is on the selection team and is prepared to ask questions at the best-and-final presentation
- Again, prioritize finding experience with:
    - High performance design
    - Modeling as-operated performance
    - Incorporating as-operated performance feedback to design

Contracts - Three Approaches

- Improve Communication
    - Reference key words and detail documents
    - Make sure they understand modeling requirements
- Structure incentives
    - Milestone performance payments
    - Doing better than required
- Define penalties
    - As-operated performance not meeting as-operated performance model

Items helpful to document and reference in contracts

- WPBT requirements
- Modeling guidance
    - How an as-operated model differs from a code model
    - Assumptions you would like them to follow
    - When first modeling results are required

Note that NREL has well-documented design-build contracting process that emphasizes performance

1. Fixed price with no change order
2. A ranked list of requirements in a design-build request for proposal (which invites teams to target higher performance)
3. Pre-award design fee with ownership of short-listed design proposal ideas - Up to 1% of project cost
4. Milestone performance payments - up to 10% of project cost.

Energy Analysis - Exhibit L

Design professionals shall submit to the University for certification:

- Documentation that the design complies with the requirements of Title 24 pt.6
- The energy compliance shall be computed using the performance-approach method of compliance approved by the California Energy Commission (CEC)
- Documentation shall be submitted on the appropriate CEC forms
- Shall be prepared using the approved CEC computer simulation programs
- Design professional shall identify the process loads and apply where required
- Design professional shall correct any non-complying aspect of the design, including its approach to energy compliance, prior to the University's certifying the design

Design Requirements

1. Design complies with and suprasses the requirements of Title-24
2. Design professional shall submit documentation of design for energy performance surpassing Title-24 by 30% and "savings by design" incentive application using the whole building approach
3. Design professional shall submit documentation of design for LEED green building design and Construction, Energy and Atmosphere Optimization Energy Performance Credit 1, demonstrating a percentage of improvement in proposed building performance rating compared with the baseline building performance rating.
4. Design professional shall submit documentation of project performance relative to UC/CSU benchmarks

Whole Building Energy Modeling
Conducted in addition to modeling for Code and LEED

- The main difference between a whole-building model and the other energy models is that operating hours and plug loads are more realistic. Standard numbers for these two inputs should not be used. Whole-building modeling will also need to account for energy efficiency measures not included in the building code.
- The Savings By Design rule set is very close to a whole-building model.
- The incremental cost should be in the noise of design team services, and the goal is to create an expectation of a performance-driven design process without a cost premium. That goes back to the point that you want to hire the right,

motivated team - not one that will see this as a significant effort outside of the primary scope. But the model itself if broken out is perhaps $10-$30K.

- It is similar to asking the question what does it cost to get LEED Gold? Architects will cost out getting additional points - $5K for this point, $15K for another point. But over time, there are many other factors that overwhelm the LEED Gold certification and it just becomes accepted as part of a reasonable fee for a UC project.
- If you have the right person on the selection committee, who can advocate for energy targets upfront, the additional cost of energy performance targets in general should be minimal.
- All ZNE buildings have to conduct a whole-building energy model. The New Buildings Institute keeps an updated list of ZNE buildings: http://newbuildings.org/2014-zne-update
- The study, “Hitting the Whole Target: Setting and Achieving Goals for Deep Efficiency Buildings”, lead authored by Karl Brown, provides more detail on whole-building energy modeling. The study includes a detailed comparison of different modeling needs that can be included in a design contract or RFP. This study is attached as a pdf.

Barriers to implementing Energy Performance Targets

The group identified the following challenges and barriers to implementing energy performance targets into building design.

- The selection committee does not include a stakeholder to represent energy efficiency.
- There has not been enough time to establish campus-specific benchmarks and targets.
- Buildings are not properly metered or sub-metered. The meters are broken and provide faulty readings.
- Tracking performance of peak energy performance targets is tricky because the peak energy load is an outlier in day to day operations.
- Some sophisticated building features are difficult to model.
- Measurement and verification of the targets once the buildings are being operated will be difficult and time consuming, especially at UC Merced where new buildings will soon be third-party owned and operated.

LEED Existing Building O+M

Online references

- http://www.usgbc.org/
- http://www.usgbc.org/Docs/Archive/General/Docs5545.pdf
- http://www.usgbc.org/resources/leed-v4-building-design-and-construction-checklist

Sustainable Sites

Credit

- Heat Island Reduction
    - Nonroof
        - Use the existing plant material or install plants that provide shade over paving areas (including
        - playgrounds) on the site within 10 years of planting. Plants must be in place at the time of
        - certification application.
        - Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot
        - include artificial turf.
        - Provide shade with structures covered by energy generation systems, such as solar thermal
        - collectors, photovoltaics, and wind turbines.
        - Provide shade with architectural devices or structures that have a three-year aged solar
        - reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use
        - materials with an initial SR of at least 0.33 at installation.
        - Provide shade with vegetated structures.
        - Use paving materials with a three-year aged solar reflectance (SR) value of at least 0.28. If threeyear
        - aged value information is not available, use materials with an initial SR of at least 0.33 at
        - installation.
        - Use an open-grid pavement system (at least 50% unbound).
    - Roof

- High-Reflectance Roof
- Use roofing materials that have an SRI equal to or greater than the values in Table 1. Meet the threeyear
- aged SRI value. If three-year aged value information is not available, use materials that meet the
- initial SRI value.
- Vegetated roof

	Slope	Initial SRI	3-year aged SRI
Low-sloped roof	≤ 2:12	82	64
Steep-sloped roof	> 2:12	39	32

- Light Pollution Reduction
  - Shield all exterior fixtures (where the sum of the mean lamp lumens for that fixture exceeds 2,500) such that the installed fixtures do not directly emit any light at a vertical angle more than 90 degrees from straight down

Water Efficiency

Prerequisite

- Indoor Water Use Reduction
  - For the indoor plumbing fixtures and fittings listed in Table 1, reduce water consumption to or below the LEED v4 for Existing Buildings: Operations & Maintenance baseline, calculated assuming 100% of the building's indoor plumbing fixtures and fittings meet the flush and flow rates listed in Table 1.

Private lavatory faucet	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Kitchen faucet (excluding faucets used exclusively for filling operations)	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Showerhead	2.5 gpm at 80 psi per shower stall	9.5 lpm at 550 kPa per shower stall

gpf = gallons per flush
gpm = gallons per minute
psi = pounds per square inch

lpf = liters per flush
lpm = liters per minute
kPa = kilopascals

- Building-Level Water Metering
    - Have permanently installed water meters that measure the total potable water use for the building and associated grounds. Metering of any gray or reclaimed water supplied to the building is encouraged but not required.

Energy & Atmosphere

Prerequisite

- Energy Efficiency Best Management Practices
    - Conduct an energy audit that meets both the requirements of the ASHRAE preliminary energy use analysis and an ASHRAE Level 1 walk-through assessment identified in the ASHRAE Procedures for Commercial Building Energy Audits or equivalent.
    - Prepare and maintain a current facilities requirements and operations and maintenance plan that containsthe information necessary to operate the building efficiently. The plan must include the following:
        - a current sequence of operations for the building;
        - the building occupancy schedule;
        - equipment run-time schedules;
        - setpoints for all HVAC equipment;
        - setpoints for lighting levels throughout the building;
        - minimum outside air requirements;
        - any changes in schedules or setpoints for different seasons, days of the week, and times of day;
        - a systems narrative describing the mechanical and electrical systems and equipment in the building; and
        - a preventive maintenance plan for building equipment described in the systems narrative.
- Minimum Energy Performance
    - Calibrate meters within the manufacturer's recommended interval if the building owner, management organization, or tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

PERFORMANCE

Meter the building's energy use for a full 12 months of continuous operation and achieve the levels of efficiency set forth in the options below. Each building's energy performance must be based on actual metered energy consumption for both the LEED project building(s) and all comparable buildings used for the benchmark.

Case 1. ENERGY STAR Rating
For buildings eligible to receive an energy performance rating using the Environmental Protection Agency (EPA) ENERGY STAR® Portfolio Manager tool, achieve an energy performance rating of at least 75.

Case 2. Projects Not Eligible for ENERGY STAR Rating
Projects not eligible to use EPA's rating system may compare their buildings' energy performance with that of comparable buildings, using national averages or actual buildings, or with the previous performance of the project building

- Building Level Energy Metering
    - Install new or use existing building-level energy meters or submeters that can be aggregated to provide building-level data representing total building energy consumption (electricity, natural gas, chilled water, steam, fuel oil, propane, etc). Utility-owned meters capable of aggregating building-level resource use are acceptable.
- Fundamental Refrigerant Management
    - Do not use chlorofluorocarbon (CFC)-based refrigerants in heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems unless a third-party audit shows that system replacement or conversion is not economically feasible or unless a phase-out plan for CFC-based refrigerants is in place

Credits

- Existing Building Commissioning
    - Evaluate the current performance of the project building against the performance specifications in the current facilities requirements and the operations and maintenance plan.
    - Identify the systems and components in the facility to be investigated and analyzed as part of the existing building commissioning or energy auditing process. Provide a breakdown of estimated resource use for each of these systems.

Option 1. Existing Building Commissioning

Develop an existing building commissioning plan to effectively inventory and evaluate specific opportunities within the systems being analyzed. The commissioning plan must include the following:

- updated current facilities requirements;
- the commissioning team members and their roles and responsibilities during the commissioning process;
- a description of the approach for identifying and analyzing facility improvement opportunities;
- the process for reviewing and prioritizing identified opportunities with the owner and developing
- an implementation plan;
- the format and content of the eventual deliverables from the commissioning process; and
- the proposed schedule.

Option 2. Energy Audit

Develop an energy audit plan following the requirements of ASHRAE Level 2, Energy Survey and Analysis, to evaluate efficiency opportunities. The audit plan must include the following:

- the audit team members and their roles and responsibilities during the audit process;
- a description of the approach for identifying and analyzing facility improvement opportunities;
- the process for reviewing and prioritizing identified opportunities with the owner and developing
- an implementation plan;
- the format and content of the eventual deliverables from the audit process; and
- the proposed schedule.

On going Commissioning Plan

Develop an on-going commissioning plan that defines the following:

roles and responsibilities;

- measurement requirements (meters, points, metering systems, data access);
- the points to be tracked, with frequency and duration for trend monitoring
- the limits of acceptable values for tracked points and metered values;
- the review process that will be used to evaluate performance

- an action plan for identifying and correcting operational errors and deficiencies
- planning for repairs needed to maintain performance;
- the frequency of analyses in the first year (at least quarterly); and
- the subsequent analysis cycle (at least every 24 months).

Demand Response??

Indoor Environmental Quality

Prerequisite

ESTABLISHMENT
Each air-handling unit in the building must comply with either Case 1 or Case 2. If some air-handling units can provide the outdoor airflow required by Case 1 and others cannot, those that can must do so.

Mechanically Ventilated Spaces
For mechanically ventilated spaces (and for mixed-mode systems when the mechanical ventilation is activated), chose one of the following:

Case 1. Systems Able to Meet Required Outdoor Airflow Rates

Option 1. ASHRAE Standard 62.1-2010
Modify or maintain each outdoor air intake, supply air fan, and ventilation distribution system to meet the outdoor air intake flow rates, using the ASHRAE ventilation rate procedure or a local equivalent, whichever is more stringent and meet the minimum requirements of ASHRAE Standard 62.1–2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quality (with errata), or a local equivalent, whichever is more stringent.

Option 2. CEN Standards EN 15251– 2007 and EN 13779– 2007
Projects outside the U.S. may instead meet the minimum outdoor air requirements of Annex B of Comité Européen de Normalisation (CEN) Standard EN 15251–2007, Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics; and meet the requirements of CEN Standard EN 13779–2007,

Ventilation for nonresidential buildings, Performance requirements for ventilation and room conditioning systems, excluding Section 7.3, Thermal environment; 7.6, Acoustic environment; A.16; and A.17.

Case 2. Systems Unable to Meet Required Outdoor Airflow Rates
If meeting the outdoor airflow rates in Case 1 is not feasible because of the physical constraints of the existing ventilation system, complete an engineering assessment of the system's maximum outdoor air delivery rate. Supply the maximum possible to reach the minimum setpoint in Case 1 and not less than 10 cubic feet per minute (5 liters per second) of outdoor air per person.

Naturally Ventilated Spaces
For naturally ventilated spaces (and for mixed-mode systems when the mechanical ventilation is inactivated), determine the minimum outdoor air opening and space configuration requirements using the natural ventilation procedure from ASHRAE Standard 62.1– 2010 or a local equivalent, whichever is more stringent. Confirm that natural ventilation is an effective strategy for the project by following the flow diagram in the Chartered Institution of Building Services Engineers (CIBSE) Applications Manual AM10,
March 2005, Natural Ventilation in Nondomestic Buildings, Figure 2.8 and meet the requirements of
ASHRAE Standard 62.1– 2010, Section 4, or a local equivalent, whichever is more stringent.

Entryway Systems

ESTABLISHMENT
Have in place permanent entryway systems at least 10 feet (3 meters) long in the primary direction of travel to capture dirt and particulates entering the building at regularly used exterior entrances. Acceptable entryway systems include permanently installed grates, grilles, slotted systems that allow for cleaning underneath, rollout mats, and any other materials manufactured as entryway systems with equal to or better performance. Maintain all on a weekly basis.

Additional Green Building Checklists

Online Resources

- CalGreen
- http://www.builditgreen.org/
- http://www.greenglobes.com/home.asp
- http://living-future.org/lbc

100 Green building rating systems used in the USA

Checklist types
-Prerequisites and option credits
-Prescriptive approach (Identify methods of achievement)
-Performance based requirements (State expectations of end results)

Use of Green Products (rating systems)
-Energy Star
-Water Sense
-Forest Stewardship Council
-Scientific Material Content Certification
-Green Seal
-Cradle to Cradle
-Green Guard

Green Building Rating System - Certification
Needs an integrated design process

Common Objective → Designed to reduce the overall impact of the built environment on human health and the natural environment.

4 Principles to be considered

1) Science based - Reproducible
2) Transparent - Open for examination
3) Objective - No conflict
4) Progressive - Advance industry practice

Not one size fits all, DYNAMIC

Funding Opportunities

Savings By Design (PG&E)

Require projects to use program if they qualify? - Should the SBD instructions by explicitly listed within the document or should the document include links to instructions and guide books. IT WILL Include links to necessary forms.

Savings by Design Guide Book (Walks through application step-by-step)

Savings by Design New Construction Form
http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/rebatesincentives/inc/cnc_application.pdf

Incentives for Customized Retrofits
Customized Retrofits Form

Automated Demand Response Program
Demand Response Form

SEP Strategic energy partnership

The Strategic Energy Partnership (SEP) program was developed by the UC Office of the President as a formal partnership with the state's investor-owned utility companies, in accordance with their mandate from the Public Utilities Commission to improve energy efficiency at large institutions. IOUEEP – Sends UC money (SEP)

UC/CSU/IOU (investor owned utilities)
Provide financial incentives and project support for energy efficiency improvements

Contains the following elements
-Monitoring based commissioning (MBCx)
-Energy Efficiency Retrofits
    Lighting and controls
    HVAC systems
    Energy Management Controls
-New Construction (Savings by Design)
-Training and education

Participating campuses may receive financial incentives
-Monitoring based commissioning (MBCx) / Retrofit: $0.24/kWh and $1.00/therm
-Lighting and controls: capped at 50% of total project cost
-HVAC systems and Energy Management Controls: capped at 80% of total project cost

-New Construction (Savings by Design): $0.10/kWh above standard SBD rates
-Training and education

Forms available at http://uccsuiouee.org

B. Key Policies

The following outlines key polices and standards for the 2015 Partnership program cycle:

- 100% incentive payment upon completion
- Lighting measures capped at 50% of project cost
- All other projects capped at 80% of total project cost
- PC Power Management cannot be bundled with any other measures
- MBCx incentive based on actual savings instead of targeted
- Closer coordination with Savings By Design for New Construction element
- Use of Primavera P6 web-based project management (UC - see Appendix C for details)
- UCOP and CSUCO centrally provided financing for state funded capital projects (projects at campus auxiliaries may be funded separately but still channeled through UCOP/CSUCO)
- Projects cannot begin without a countersigned agreement issued by the IOU (no construction pre-approvals will be allowed)
- Invoices: Upon project completion, the University needs to provide the IOU with itemized invoices for parts and labor as it relates to the project.

Different forms/project types

Form B: Retrofit Application

Form C: MBCx Application

Form C.1: Building Benchmarking for MBCx (UC required)

Form D: MBCx Summary Report

Form E: Project Completion Form

PUC (Public Utilities Commission) partnership program
General Information – CA Energy Efficiency Plan
http://www.cpuc.ca.gov/NR/rdonlyres/A54B59C2-D571-440D-9477-3363726F573A/0/CAEnergyEfficiencyStrategicPlan_Jan2011.pdf

http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Local+Government+Programs+and+State+and+Institutional+Partnerships.htm (Website includes other links and some general information, living document should utilize these hyper links)

Budget and Finances

http://www.cpuc.ca.gov/NR/rdonlyres/3BACFA54-7073-4E17-A281-7A31F6794662/0/GovtPartnershipsFactSheet20132014rev51614.pdf

Sources

UCOP Sustainable Practices Policy:
http://policy.ucop.edu/doc/3100155/Sustainable%20Practices

Benchmarking

https://www.dropbox.com/s/ip7pq5h3v0nsnfr/Whole-Building%20Energy%20Performance%20Targets%20for%20UC%20Buildings-2.pdf?dl=0