State of California
M e m o r a n d u m

CAL POLY
SAN LUIS OBISPO

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Subject: High Performance Building Policy for Major Capital Projects

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As a Charter Signatory to the Second Nature Climate Commitment, Cal Poly is committed to achieving carbon neutrality and climate resilience "as soon as possible" – currently targeted for 2050. A significant opportunity exists to integrate this goal into the way new buildings are designed and constructed. Sustainability goals and requirements for new construction and major renovations are also set forth by CSU Sustainability Policy:
http://www.calstate.edu/cpdc/sustainability/policies-reports/documents/JointMeeting-CPBG-ED.pdf

> *"1. All future CSU new construction, remodeling, renovation, and repair projects will be designed with consideration of optimum energy utilization, low life cycle operating costs, compliance with all applicable energy codes (enhanced Title 24 energy codes) and regulations. In the areas of specialized construction that are not regulated through the current energy codes, such as historical buildings, museums, and auditoriums, the CSU will ensure that these facilities are designed to consider energy efficiency. Energy efficient and sustainable design features in the project plans and specifications will be considered in balance with the academic program needs of the project within the available project budget.*
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> *2. Capital Planning, Design and Construction in the Chancellor's Office shall monitor building sustainability/energy performance and maintain information on design best practices to support the energy efficiency goals and guidelines of this policy. The sustainability performance shall be based on Leadership in Energy and Environmental Design (LEED) principles with consideration to the physical diversity and microclimates within the CSU.*
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> *3. The CSU shall design and build all new buildings and major renovations to meet or exceed the minimum requirements equivalent to LEED "Silver." Each campus shall strive to achieve a higher standard equivalent to LEED "Gold" or "Platinum" within project budget constraints. Each campus may pursue external certification through the LEED process."*

Every new project that is constructed should strive to advance the university toward its climate neutrality goal. CSU policy establishes a recommended framework by which to achieve that –

optimum energy efficiency, life cycle cost analysis, and minimum LEED Silver equivalency while striving for Gold or Platinum. New buildings that result in increased greenhouse gas emissions will necessitate implementation of additional conservation projects to offset that growth, reducing the funding available for other critical conservation and deferred maintenance needs. The Sustainability Advisory Committee has a charge from the Senior Vice President of Administration and Finance to:

> *"… review and recommend measures related to University sustainability policies and practices dealing with natural resource utilization, land use, and physical projects. The committee is advisory and reports to the vice president of Administration & Finance. The committee is to consider issues related to environmentally responsible planning, design, and construction, as articulated in the Campus Master Plan. In addition, it will provide advice on the continuing efforts to construct environmentally sustainable projects. In its advisory capacity, the committee needs to consider the goals of sustainable development, which are balancing environmental protection, programmatic needs, and financial viability."*
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> *"…The committee is to provide input to the Campus Planning Committee related to special projects."*

In order for the committee to successfully fulfill its charge, it is critical that it have the opportunity to review and provide input on projects at an appropriate point during planning and design. This will ensure committee recommendations can be evaluated and incorporated by the design team without negatively affecting the project schedule or budget. The Committee will work through the Campus Planner to give a presentation to the committee on each physical project at the completion of design development, with an overview of the sustainability aspects and goals of the project (see checklist below). The committee will review each project against industry best practice planning and design standards articulated herein with the goal of creating high performance buildings with the lowest possible greenhouse gas emissions and total cost of ownership. The intent of procedures recommended in this document is to integrate these recommendations into the workflow of FPCP and SBS at the appropriate stage of the project to ensure success, so that review by the Sustainability Advisory Committee at 100% DD will not be uncovering problems when they are too late or too costly to remedy.

Best Practices for Managing Total Cost of Ownership

For State funded projects, a fundamental disconnect exists in which capital funds for design and construction are separate from funding for operations, maintenance, utilities, and capital renewal. Budgetary constraints during planning, design, and construction necessitate compromises that can increase the cost of utilities, maintenance, repair, and renewal over the life of the building, exacerbating the campus' deferred maintenance backlog and maintenance staffing limitations.

Data published by the National Institute of Building Sciences shows that over a 30 year period, the costs of operations, maintenance, and utilities are on average three times the initial cost of design and construction: https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca. If the life of a building is longer than 30 years, this ratio increases – Cal Poly buildings have a life much greater than 30 years. A financial approach that balances both up front and long term operating costs is key to success, and is referred to as Life Cycle Cost Analysis, or Total Cost of Ownership.

In Federal Government, the General Services Administration has recognized this and mandates in the Code of Federal Regulations, Title 10, Part 436, Subpart A, that 20 year Life Cycle Cost Analysis must evaluate both upfront capital cost as well as the cost of operation, maintenance, energy and utilities. Energy modeling must be performed for multiple building envelopes and energy systems, and design selection based on Life Cycle Cost: https://www.gsa.gov/portal/content/101197

The Value of LEED as a Proven Framework to Guide Integrated Design

Post Occupancy Evaluation of 22 Federal GSA buildings (16 LEED Certified and 6 non-certified but using sustainably focused design criteria such as EPA Energy Star) found the following measurable performance improvements as compared to the national average for buildings of the same type - https://www.gsa.gov/graphics/pbs/Green_Building_Performance.pdf:

- 25% reduction in energy use
- 19% reduction in aggregate operating cost
- 27% higher occupant satisfaction
- 36% reduction in greenhouse gas emissions

In addition to reduced operating costs for more efficient buildings, studies show that buildings with higher levels of LEED Certification not only have greater energy and water efficiency and therefore lower utility costs, they also receive numerous benefits that improve occupant satisfaction and performance, including:

- Improved light quality, availability of daylight, and occupant control of lighting
- Improved thermal comfort, enhanced occupant control of temperature and ventilation
- Greater indoor air quality from increased fresh air ventilation and enhanced filtration
- Reduced exposure to volatile organic compounds (VOC's) from the off-gassing of building materials

The United States Green Buildings Council publishes research data from numerous studies and sources demonstrating the health, productivity, and financial benefits of the improved indoor environment that result from a LEED driven design approach:
http://www.usgbc.org/articles/business-case-green-building

- 9-27% reduction in headaches, allergies, asthma, and communicable respiratory infections
- 16% increase in worker productivity and student academic performance
- Reduced absenteeism and improved employee retention
- Higher lease/rent values as compared to minimally code compliant buildings

In "The Cost of Green Revisited" (http://sustainability.ucr.edu/docs/leed-cost-of-green.pdf) by construction consulting firm Davis Langdon, a sample size of 221 buildings was analyzed to understand the cost-benefit of LEED certification. Building types included academic, laboratory, library, community center, and ambulatory care facilities. Of the 221 buildings analyzed, 83 were designed to meet some level of LEED certification. The remaining 138 buildings were of similar program type, but did not have a fundamental goal to incorporate sustainable design or achieve LEED certification. All costs were normalized for time and regional factors. The study found:

- There was no direct correlation between LEED certification level and construction cost per square foot - LEED certified buildings were randomly distributed across the sample when ranked by cost per square foot
- The majority of LEED certified buildings achieved their sustainability goals within the original project budget

This and other studies found that the greatest drivers of final building construction cost were:

- Building type, region, and market pressures on material and labor
- Use of an integrated design approach, with strong collaborative teams and early goal setting, vs projects with poor planning, unclear goals, or an attempt to add "green" features late in the design process
- Effectiveness of project/construction administration procedures to control quality, schedule, and budget

The LEED certification system is therefore found to be an excellent framework to guide and quantify sustainable design of high performance buildings, as long as it is an integral part of programming, design, construction, and commissioning. The only clearly demonstrable cost of LEED is the cost of application and certification itself, which is very small in comparison to a typical building construction budget. The cost of project registration and certification by the USGBC ranges from $0.03 to $0.05 per square foot. The cost of the design consultant's work to produce all necessary documentation varies by project, but will range between $50k and $150k per project. These expenses are rapidly recovered in reduced operating costs.

In the case of Cal Poly's 188,400 gsf Baker Center for Science, the high-performance standards that were set at the beginning of the design process are demonstrating a high return on investment over the life of the building. By utilizing the Sustainability Charrette process at design kickoff, and using the LEED framework to guide the design and decision making process, the Baker Science design resulted in a building that outperforms the energy code by 40%. This was done within the project budget, and the building achieved LEED Gold Certification. The high performance building envelope and energy systems result in a reduction in annual operating cost of $245,000 in the first year of operation. Assuming an average annual utility cost escalation of 4% for electricity and natural gas, this results in a cumulative 30 year savings of $13.7 million. Operational savings of high-performance buildings, and utility Energy Design Assistance (formerly Savings by Design) incentives will more than cover any incremental cost of LEED documentation in the first year, meaning that investment has an ROI greater than 100%. Cal Poly cannot afford to build minimally code compliant buildings in the future – it simply does not make economic sense.

There will inevitably be situations where a donor is not willing to fund LEED certification or efficiency measures above and beyond minimal code compliance. It is not the intent of this recommendation to suggest such gifts should be rejected out of hand, but to provide campus leadership with information for informed decision making and organizational planning. A variety of strategies could be used to address these issues in the case of donor funded projects:

- Since the primary driver is often financial, some donors may change their thinking once they understand the life cycle impact of the facility they are donating. This presents an opportunity to engage and educate potential donors on Cal Poly's approach to integrated and sustainable design, data driven decision making, and the value of life cycle cost analysis as is taught in Cal Poly's architecture, engineering, and business programs.
- Additional fundraising could be undertaken to augment a donor gift, with the goal of achieving lowest life cycle cost for the project.
- Campus funds could be used to augment donor funds, with the goal of achieving lowest life cycle cost for the project.
- If additional funding cannot be obtained to go beyond minimal code compliance or pay for LEED certification, an analysis of the operation, maintenance, and utility costs for the life of the project as compared to a best practice standard should be performed so that the administration can understand the impact to existing budgets, staffing, and service levels.

Cal Poly High Performance Building Policy Requirements

The following best practices and sustainability goals shall be included in Cal Poly's Design Standards and Campus Construction Standards for selection of, and communication with, design teams at the beginning of each project, and be integrated into project documents to ensure they are contractually enforceable. This will help designers better understand CSU and Cal Poly sustainable development goals and policies, and the strategies that have been successful on our campus. These include:

1. Design team selection criteria shall include demonstrated experience designing high performance, net zero, and LEED Platinum certified buildings on university campuses.
2. The project shall convene a Sustainability Charrette to involve all stakeholders (design team, client, operations and maintenance staff, contractors, Building Automation System vendor, commissioning agent, etc.) at design kickoff. The charrette will establish sustainability goals (i.e. target EUI, % exceedance of T24, LEED certification level, etc) and metrics for the project to help guide design decisions. Progress toward these goals shall be tracked and reported to the designated Cal Poly Project Manager and Director of Energy, Utilities, and Sustainability at each design submittal. The NREL Charrette Handbook or equivalent shall be used as a model: http://www.nrel.gov/docs/fy03osti/33425.pdf. The design team shall become familiar with Cal Poly's Climate Action Plan – PolyCAP – prior to the charrette: https://afd.calpoly.edu/sustainability/campus_resources/climate_action
3. The design shall prioritize high performance building envelope, mechanical, and lighting systems, and incorporate passive features to reduce the size and energy use of building systems via siting, orientation, thermal massing, shading, natural ventilation, and daylighting.
4. Schematic design shall include energy modeling and evaluation of at least 3 options for each major building system, with selection based on 30 year life cycle cost analysis (including O&M

of all building components/systems) and lowest greenhouse gas emissions using the CSU LCC worksheet or equivalent:
https://www2.calstate.edu/csu-system/doing-business-with-the-csu/capital-planning-design-construction/Documents/Life_Cycle_Cost_Worksheet.xls

5. To minimize project related impacts of transportation, commuting, and parking, the project shall evaluate and strive to reduce net greenhouse gas emissions from commuting by incorporating or expanding bicycle access and parking, electric vehicle charging, and other sustainable transportation infrastructure.

6. The project shall exceed Title 24 (or ASHRAE 90.1 for projects not subject to Title 24) by a minimum of 30% for new construction or major renovation (as per Cal Poly's Climate Action Plan and Master Plan EIR Mitigations) with an aspiration to achieve Zero Net Energy via rooftop solar PV, solar thermal, or other technology as appropriate. Note: Zero Net Energy will be required by Title 24 for residential buildings starting in 2020, which will apply to University housing buildings up to 3 stories. Zero Net Energy will be required by Title 24 for commercial buildings starting in 2030, which will apply to all academic/support buildings and University housing buildings over 3 stories. Until ZNE definitions and Title 24 compliance paths are finalized, design consultants should use the US Department of Energy's "Common Definition for Zero Energy Buildings", as adopted by State agencies:
https://energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf
Note: as of the 2019 code cycle, Title 24 requires Quality Insulation Installation (QII) prescriptive requirement rather than a compliance credit.

7. Projects shall evaluate the potential for rooftop solar PV. If the project budget can afford to procure and install a PV system, that provides the greatest benefit to the University as the energy produced is free for the life of the system. If the project budget cannot afford to pay for a PV system, one may be developed using a Power Purchase Agreement (PPA) using CSU contract templates and pre-qualified vendors. If done via PPA, the design team shall work with the University to solicit proposals using the CSU MEA, and shall be responsible to oversee the solar vendor's design, the utility interconnection application and approval process, and scheduling, oversight, and inspection of PV system design and construction in coordination with the University. If it is not possible to incorporate rooftop solar PV within the project budget or via PPA during construction, but the roof is appropriate for future PV development based on usable area, orientation, and shading, the design shall at a minimum make the building solar PV ready, including:

   a) Structural evaluation of future PV loading of up to 5 psf, and the calculations to support such.
   b) A circuit breaker in the service switchgear dedicated for future PV. If the service switchgear is not large enough to accommodate a load side breaker, the solar (contingent on calculations and code) can be connected with a line side tap. If the switchgear is ordered as 'PV ready' and labeled as such for the line side tap, the contractor won't have to coordinate with UL during the physical interconnection to get the gear re-listed by UL.
   c) Bi-directional meter at service switchgear for PV, integrated to the campus SCADA system.
   d) Conduit pathway from service switchgear to roof or penthouse electrical room.

e) A location in the appropriate electrical room for future PV equipment along with identifying a path for equipment to be installed and removed.
f) PV inverters shall be specified as "smart" inverters, capable of real and reactive power control for future integration into a microgrid.
g) Layout of roof equipment (such as exhaust fans, equipment penthouses, and other objects that take up space and create shading, all the way down to conduit runs and plumbing vents) should take into consideration how to maximize the size of a PV array by providing open clear space with good solar exposure and minimal shading. This needs to be done in an integrated manner to address required roof setbacks from the edge, how fall prevention will be addressed (for buildings without adequate parapet walls requiring an engineered fall restraint anchorage system), and to provide walkways for maintenance access to all roof equipment that could require inspection or service.
h) Pathways for "solar ready" should also include a way to connect the smart inverter to campus backbone Ethernet for communication/remote monitoring. This would require a separate pathway from power conductors by code, and would need to go to a telecomm room rather than main electrical room.
i) The design team shall consider:
    a. Installation of stanchions (typically ~24" tall 2" galvanized pipe anchored to concrete deck with a base plate and welded cap on top) on an appropriate spacing interval to support an array using an off the shelf racking system. This would ensure that all penetrations of the roof membrane are done when the roof is installed, and are covered under the original roof warranty. This would also remove this cost of mounting infrastructure from the solar project if delivered via PPA, bringing down the price of the PPA in perpetuity, or;
    b. Preparations for a ballasted PV system rather than fixed tilt requiring structural attachment. This might require specification of a certain type of rigid insulation under the roof membrane to ensure that the ballasted system does not crush it, creating low spots that will pool water and degrade the life and performance of the membrane and insulation. The roofing material submittal shall include the manufacturer's requirements for solar PV.

8. To reduce embedded carbon and facilitate supply from renewable energy sources, the project shall prioritize electricity as the primary energy source rather than natural gas, except for heating systems served by the campus central plant.

9. For projects that require backup or emergency power, the design team shall consider alternatives to the use of diesel generators, which require an Air Pollution Control District (APCD) Permit to Operate for units of 50 engine horsepower or larger, and compliance with increasingly strict emissions limits. Alternatives may include natural gas or dual-fuel natural gas/propane generators which do not require an APCD permit, or batteries. Much like solar PPA's, the CSU has a Master Enabling Agreement with several pre-qualified battery vendors to streamline procurement and installation of battery systems. The CSU's battery MEA finances these systems via a shared savings agreement with the battery vendor, based on projected utility demand charge savings from peak load shaving and time-of-use load shifting. If batteries are selected as the solution by the design team, the builder shall be responsible to work with Cal Poly's Strategic Business Services department to contract with the battery

vendor to design, construct, and commission the battery system as part of the project. The shared savings agreement shall be executed between the battery vendor and Cal Poly, and should allow the battery system to be procured and installed with little or no capital required from the project budget.

10. The project shall achieve LEED Gold Certification, with an aspiration for LEED Platinum. All application fees, data collection, documentation, submission to GBCI, and response to GBCI feedback through receipt of Certification shall be the responsibility of the design team.
11. The LEED certification process shall prioritize points that result in reduced energy and water use, and satisfy requirements for Enhanced Commissioning of both MEP systems and the building envelope (including insulation and moisture barrier/waterproofing details), and Advanced Energy Metering.
12. The project shall integrate the building automation system with the campus' Energy Information System for both commissioning of the project and continuous commissioning thereafter.
13. The project shall evaluate opportunities to implement green roofs, rainwater catchment, grey water reuse, bioswales, future availability of recycled water for toilet flushing and other permissible uses, and permeable surfaces in hardscape.
14. Landscape design shall prioritize use of native and water efficient plant species, minimization of turf area, and integration with the campus' CalSense wireless irrigation control system including flow meters and master valves, and shall be ready for conversion to recycled water when available in the future.
15. The project shall incorporate space in building interiors for Zero Waste collection stations and signage at strategic locations on each floor, and outdoor waste collection infrastructure and campus standard signage to prioritize recycling or composting over landfill.
16. The project shall incorporate filtered (but not chilled) water bottle filling stations on each floor.
17. The project shall evaluate and incorporate where appropriate high efficiency hand dryers in restrooms and eliminate paper towel dispensers, and shall specify campus standard toilet paper dispensers designed for tubeless paper rolls.
18. Materials, surfaces, and finishes shall be selected for long life and durability, with low/no maintenance requirements.
19. The project shall apply for PG&E and SoCalGas Energy Design Assistance incentives through the UC/CSU Energy Efficiency Partnership Program, which incentivizes building energy performance that exceeds Title 24 by a minimum of 10%: https://www.uccsuiouee.org/new-construction. Applications shall be completed by the design team and submitted to both utilities at 100% schematic design to ensure any useful design feedback can be incorporated into the project. California Energy Design Assistance incentives may be used to offset the cost of LEED Certification. The program includes a separate incentive for the design team (up to $50K) intended to offset any additional expenses for documentation/submission.
20. Upon transmittal of 100% DD drawings, the Campus Planner (with support from design team if needed) shall present the project design to the Sustainability Advisory Committee covering the following items:

General Project Overview – 5 minutes:

- Who is the client, why are we building this building, how was this site selected, and will anything need to be demolished to prepare?
- What is the building type (or mix), who will occupy it, and what is the total GSF?
- What is the project budget and funding source?
- What is the planned completion date?
- Who is the A&E team and what is the chosen project delivery method?
- How is the project consistent with Master Plan goals? (i.e. protection of prime ag land, high density infill development, etc)
- Where are we in the design process? (ideally these presentations will take place at 100% DD)

Sustainability Aspects of the Project – 30 minutes:

- What is the design team's approach to integrated and sustainable design?
    - Was there a sustainability charrette at design kickoff?
    - What were the charrette results and building performance goals chosen? (i.e. exceedance of Title 24, LEED certification goal, participation in Energy Design Assistance, LABS21 goals)
    - Were Campus Standards communicated with the design team at design kickoff, and are they being followed?
    - How is stakeholder input/feedback being solicited and integrated into the design?
- Please describe the design features chosen or under consideration for energy efficiency for:
    - HVAC and controls – Type of mechanical systems chosen? Siemens involved early? Aircuity for labs?
    - Air conditioning – how much of the building will be cooled? Central Plant or local? Total tonnage? Are there any package AC units - VRF or high SEER, and how will they be integrated with BAS?
    - Lighting and lighting controls – LED? Dimming and daylighting? Software for central control? Emergency lighting – generator or battery?
    - Lab or other Group II equipment efficiency? Energy Star for appliances?
    - Elevators – energy recovery type?
    - Building envelope – passive features, natural ventilation, cool roof, high performance insulation and glazing?
    - Commissioning – who is the Cx agent, when were they brought in (ideally at the Sustainability Charrette at schematic design kickoff), and how will they verify performance vs design after occupancy?
- Please describe the design features chosen or under consideration for water efficiency for:
    - Low flow plumbing fixtures
    - Lab or process water use
    - Rain catchment/storage/reuse
    - Grey water reuse
- Please describe the design features chosen or under consideration for site sustainability:
    - Water wise landscape – turf vs native/drought tolerant plantings
    - Integration with CalSense wireless irrigation control system
    - Storm water management – bioswales, permeable surfaces, green roofs, etc.
    - Construction site tree protection or relocation/replacement – especially for unique species
- Solid Waste management
    - Location/size of main landfill/recycle dumpsters, garbage truck access
    - Indoor waste stations – type/size/locations/signage, no interference with building egress
- Transportation

- Bike racks and lockers?
- Commuter shower?

Question and answer – 10 minutes

21. Should the project require value engineering (VE) or value management (VM) for budget control, the design team must first consider items that will not degrade building energy performance or significantly increase maintenance workload. Proposed alteration or elimination of any design feature that will negatively affect building energy performance or maintenance workload shall be analyzed to determine the life cycle cost impact to the utility and maintenance budgets and be submitted to the Executive Director of Facilities Planning and Capital Projects and Executive Director of Facilities Operations for approval.
22. Upon project completion, and as part of the Commissioning Agent's scope of work to monitor the building over its first year of occupancy, the actual performance of the building shall be measured and compared to the design goals established at the Sustainability Charrette, and the final energy model used for T24 compliance, LEED Certification, and California Energy Design Assistance incentives. Achievement or progress toward all Charrette goals shall be reported to the Executive Director of Facilities Planning and Capital Projects and Executive Director of Facilities Operations for ongoing process improvement.
23. Upon project completion or approval for beneficial occupancy by the State Fire Marshal, when control of the building transfers from FPCP to Operations, the following items shall be substantially complete (with a plan, schedule, and assigned responsibility to resolve all open items in a timely manner within the warranty period), fully documented, submitted to and accepted by the University, and shared with Fac Ops:
    - Punch list
    - Commissioning (except for remaining Cx tasks required post-occupancy)
    - Test and Balance (TAB)
    - As-Built drawings, equipment submittals, and approved substitution requests
    - Operation and Maintenance manuals
    - Contractually required training and training documentation
    - Warranty documentation for all building components/equipment/systems with contractually specified or manufacturer's warranties longer than one year
    - Contact information for transmittal/escalation of warranty items to the contractor with clear roles and responsibilities between the PM, Fac Ops, and department staff
    - Documentation of department vs. FMD equipment/system maintenance responsibilities, and a written plan (coordinated with and signed by the department) for how preventive maintenance will be performed on equipment that is the department's responsibility - by department staff, contractor, or by FMD via recharge
    - Submittal of all building component/equipment/system nameplate data and manufacturer's recommended maintenance tasks and frequencies in Cal Poly templates for entry into Planon for preventive maintenance
    - Creation of PM work orders in Planon to inspect all building components/equipment/systems for potential warranty issues 11 months after the start of the warranty period