SUSTAINABLE DEVELOPMENT FRAMEWORK

San Francisco State University

2017

GLOSSARY OF TERMS*

All gender: Descriptive phrase denoting inclusiveness of all gender expressions and identities.[1]

Biophilia: The practice of incorporating nature and natural elements into the built environment is known as biophilic design. It has been proven to measurably reduce stress, increase learning rates, enhance cognitive function and creativity, and expedite healing.

Blackwater: wastewater containing urine or fecal matter that should be discharged to the sanitary drainage system of the building or premises in accordance with the International Plumbing Code. Wastewater from kitchen sinks (sometimes differentiated by the use of a garbage disposal), showers, or bathtubs is considered blackwater under some state or local codes.

Energy use intensity (EUI): EUI expresses a building's energy use as a function of its size or other characteristics. EUI is often expressed as energy per square foot per year.

Graywater: "untreated household waste water which has not come into contact with toilet waste. Graywater includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washers and laundry tubs. It must not include waste water from kitchen sinks or dishwashers" (Uniform Plumbing Code, Appendix G, Gray Water Systems for Single-Family Dwellings); "waste water discharged from lavatories, bathtubs, showers, clothes washers and laundry sinks" (International Plumbing Code, Appendix C, Gray Water Recycling Systems). Some states and local authorities allow kitchen sink wastewater to be included in graywater. Other differences can likely be found in state and local codes. Project teams should comply with the graywater definition established by the authority having jurisdiction in the project area.

Integrated design and delivery (ID+D): This approach involves people, systems, and business structures (contractual and legal agreements) and practices. The process harnesses the talents and insights of all participants to improve results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.

Life-cycle assessment (LCA): LCA is an evaluation of the environmental effects of a product from cradle to grave, as defined by ISO 14040–2006 and ISO 14044–2006.

Low-impact development (LID): LID is an approach to managing rainwater runoff that emphasizes on-site natural features to protect water quality, by replicating the natural land cover hydrologic regime of watersheds, and addressing runoff close to its source. Examples include better site design principles (e.g., minimizing land disturbance, preserving vegetation, minimizing impervious cover), and design practices (e.g., rain gardens, vegetated swales and buffers, permeable pavement, rainwater harvesting, soil amendments). These are engineered practices that may require specialized design assistance.

Net Positive Energy: Achieving Net Positive Energy means producing, from renewable resources, *more* energy on site than is used over the course of a year.[2]

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[1] Adapted with permission from JAC Stringer of The Trans and Queer Wellness Initiative (2013) JAC (at) transqueerwellness.org, http://www.TransQueerWellness.org

[2] www.epa.gov

Stormwater management: systems employed to reduce pollution and hydrologic instability from stormwater, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions.

Vapor profile: An assessment of the vapor permeabilities of each component in a building assembly (a wall, ceiling, or roof). This assessment determines the assembly's drying potential and its drying direction. The vapor profile shows whether the building assembly protects itself from getting wet and how it dries when it gets wet.[3]

Zero Net Energy (ZNE): Achieving Net Zero Energy means producing, from renewable resources, *as much* energy on site as is used over the course of a year.[4]

Zero Waste: Achieving Net Zero Waste means reducing, reusing, and recovering waste streams to convert them to valuable resources with zero solid waste sent to landfills over the course of the year.[5]

* Unless otherwise noted, all definitions are sourced verbatim from USGBC glossaries

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[3] www.greenbuildingadvisor.com
[4] www.epa.gov
[5] www.epa.gov

Part A. WORKING WITH SF STATE

A.1 PURPOSE

San Francisco State University (SF State) has created a Sustainable Development Framework (SDF) to support the achievement of its campus-wide sustainability goals. This Framework delineates SF State's sustainability mandates and expectations for all: planning, design, major renovation and construction projects undertaken by and for SF State. The SDF describes specific performance requirements – from energy and water efficiency and reuse, to renewable energy production, and more – and provides guidance and tools to assist project teams in meeting them.

In many cases, these performance based design requirements reach beyond current local and state building codes. For project teams to succeed, the Sustainable Development Framework needs to be considered in full before the design process begins. One of the goals of the SDF is to promote, build and support more collaborative design processes and more integrated project teams. The SDF is here to do more than encourage industry standard sustainability best practices. If used properly, the SDF will help each project team understand how its design and performance requirements fit into SF State's overall strategy to be a more walkable, livable, zero net energy and net zero water campus. This extends beyond building systems level thinking. It connects performance with beauty and, where possible, includes considerations of shared risk, shared reward, and contract delivery methods, specifically the use of performance based design build processes to secure large-scale low-energy buildings. With SF State's ambitious sustainability goals, working at SF State requires real estate and design teams to think beyond current building industry norms and code minimum design. Each project team should take to the time to understand how to meet those goals on budget and on time using creative, cost effective architectural and integrative building systems solutions.

Each project team needs to take the time to fully understand that SF State considers 'good design' and 'sustainable design' to be the same. This is a perspective in which performance and beauty are not mutually exclusive, nor does sustainability limit a design team's ability to provide high quality design on time and on budget.

Every project team is expected to be well-equipped to meet these requirements and well-informed as to the attitudes, skills, resources, and experience necessary to do so successfully. All teams will focus on accomplishing these performance requirements *in equal measure* to their focus on meeting conventional requirements such as those related to budget, schedule, durability, safety, etc.

Every submitted proposal or qualifications document will include a summary of how SDF requirements will be achieved, including a statement of the submitting organization's qualifications to meet the stated performance requirements relevant to the project in question, examples of similar project work and the resources the organization will utilize in meeting SDF guidelines.

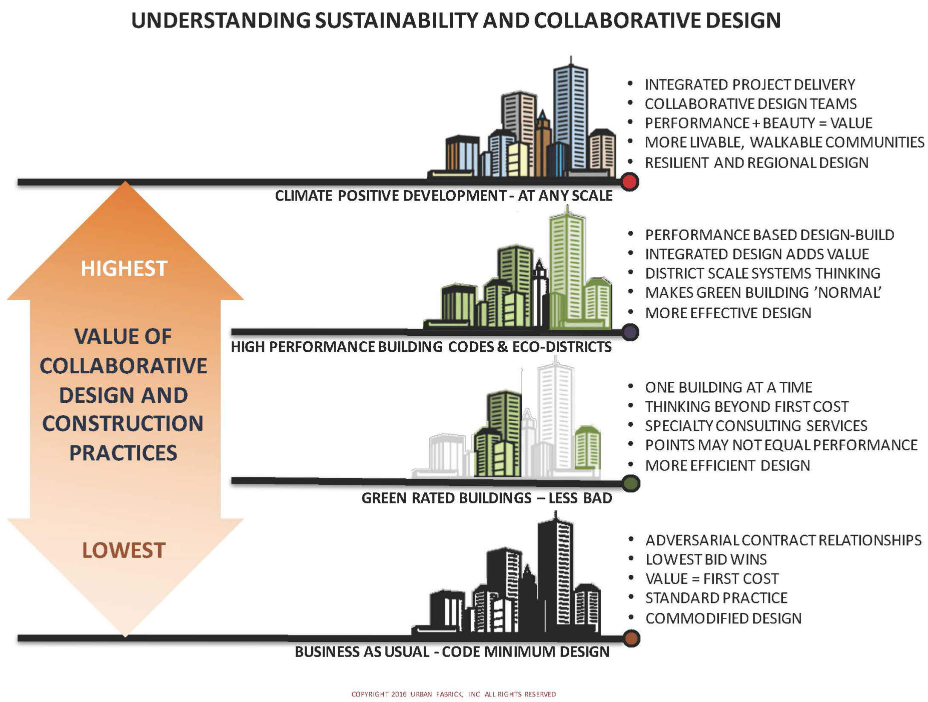
Upon commencing a project, performance requirements – including this SDF – will be incorporated into the project's *Basis of Design* and *Owner's Project Requirements*, as specified in the applicable LEED rating system. Project teams will report on progress towards meeting the Framework's performance targets at established project milestones.

OUT-OF-STATE FIRMS: *California's building code – specifically, Title 24, Part 6 (the energy code) and Title 24, Part 11 (CalGREEN) – contains provisions that are more stringent than codes in most other parts of the US.*

Figure A1. SF State's High-Level Sustainability Goals

1. **Positive campus community member experience**
2. **Zero waste; achieve 80% solid waste recycling by 2020**
3. **Climate-neutral operations**
   - By 2020, reduce GHG emissions by 25% below 2020 baseline.
   - By 2040, reduce GHG emissions by 40% below 2020 baseline.
   - Target zero net energy for the campus as a whole.
   - Achieve zero net energy (ZNE) for all new facilities. Note: the State of California has required all new residential construction to be ZNE by 2020 and all new non-residential be ZNE by 2030.
   - Target all-electric kitchen and MEP building systems.

Figure A2. Hierarchy of Building Practices – Conventional to 'Green' to Regenerative



The above infographic (Figure A2) summarizes the value of collaborative design and construction practices ranging from code-minimum design to climate-positive development. True collaboration requires a project team leader who understands how to effectively build trust across the team and manage a more complex design process, and not simply direct the design.

A.2 APPLICABLE RATING SYSTEMS AND CRITERIA

Many of the performance requirements herein are based on third-party rating systems and other resources; the specific applicable criteria are referenced in the relevant sections of this Framework. These rating criteria are utilized as the foundation for this Framework because they represent the building industry's best thinking and expertise as to what are truly the best practices in a given area or discipline, as well as how to implement those practices and how they can be credibly verified.

Each project team is responsible for knowledge of the specific requirements imposed by the rating

criteria referenced herein.

The principal sources of these criteria are:

- **LEED (Leadership in Energy and Environmental Design).** All eligible projects will achieve Gold or Platinum certification in the applicable LEED rating system. In addition, every project will pursue all applicable LEED Master Site credits, whether or not the project is eligible for certification. See Figure A3 for a list of the LEED Master Site credits selected for SF State. These credits are indicated in this Framework by the ✪ symbol. In some instances, campus-wide compliance can be used by each project in lieu of single-project compliance, as indicated in Figure A3.
- **City and County of San Francisco Building Code.** Although not in force at SF State, the University acknowledges and seeks to exceed this code.

Figure A3. Summary of City and County of San Francisco Sustainable Building Standards

	NEW CONSTRUCTION				ADDITIONS AND ALTERATIONS		
	LARGE COMMERCIAL	ALL OTHER NON-RESIDENTIAL	HIGH-RISE RESIDENTIAL	LOW-RISE RESIDENTIAL	FIRST-TIME COMMERCIAL INTERIORS	MAJOR COMMERCIAL ALTERNATION	ALL OTHER ADDITIONS & ALTS TO COMMERCIAL
OCCUPANCY	A, B, I, M	A, B, I, M	R	R	A, B, I, M	B, M	A, B, I, M, E, F, H, L, S, U
SIZE (SQ.FT.)	≥ 25,000	<25,000	≥ 4 OCCUPIED FLORRS	1-3 OCCUPIED FLOORS	≥ 25,000	≥ 25,000 & w/ SIG. S OR MEP	≥ 1,000
VALUE							ADDITION OR ALTERATION ≥ $200K
STANDARD TO BE MET	LEED GOLD	NONE	GPR or LEED SILVER	GPR or LEED SILVER	LEED GOLD	LEED GOLD	TITLE 24 PART 11
USE SUBMITTAL FORM	C-3 LEED	C-5 NON-RES	C-3 LEED or C-4 GPR	C-3 LEED or C-4 GPR	C-3 LEED	C-3 LEED	C-5 NON-RESIDENTIAL C-6 *STREAMLINED FOR* TIs
ATTACHMENT REFERENCE	B TABLE 1	B TABLE 3	B TABLE 1 LEED *or* TABLE 2 GPR	B TABLE 1 LEED or TABLE 2 GPR	B TABLE 1	B TABLE 1	

Additional rating systems, elements of which are referenced herein, are:

- LEED for Neighborhood Development (LEED-ND)
- WELL Building Standard (WELL)
- Sustainable Sites Initiative (SITES)
- Living Building Challenge (LBC)
- Living Community Challenge (LCC)

When multiple rating system credits are referenced in a sub-section of this Framework, they are included because they are either substantially different and/or apply to different project types. Determine which credits, or aspects thereof, are applicable in consultation with University staff.

In many cases, a rating system credit is provided to define performance expectations, irrespective as to whether it may be earned within a rating process for a particular project.

Similarly, while all detailed requirements of a given credit may not be achievable based on the nature of a specific project, teams are nevertheless expected to apply the relevant principles and practices to the extent possible.

Figure A3. LEED Master Site Credits for SF State

LEED Score Card

Tag	Credit Title		Points				
			Master Site	Developer Mandatory	Optional	Policies or Code	Design Standards or Standard Practice
Sustainable Sites = 24			**18**	**4**	**2**		
SSp1	Construction Activity Pollution Prevention			Y		Cal-Green Code	
SSc1	Site Selection	Not Used					
SSc2	Development Density and Community Connectivity	UCM will provide all documentation for this credit	5				
SSc3	Brownfield Development	Not Used					
SSc4.1	Alternative Transportation – Public Transportation Access	UCM will provide all documentation for this credit	6				
SSc4.2	Alternative Transportation – Bicycle Storage and Changing Room			1		Cal-Green Code	Walk-in Shower is required in Gender Neutral Bathroom
SSc4.3	Alternative Transportation – Public Transportation Access	UCM will provide all documentation for this credit	3				
SSc4.4	Alternative Transportation – Public Transportation Access	UCM will provide all documentation for this credit	2				
SSc5.1	Site Development – Protect or Restore Habitat	UCM will provide all documentation for this credit	1				
SSc5.2	Site Development – Maximize Open Space	UCM will provide all documentation for this credit	1				
SSc6.1	Stormwater Design – Quantity Control			1		LRDP, pg 102 Storm Water	
SSc6.2	Stormwater Design – Quality Control			1		Sust-12	
SSc7.1	Heat Island Effect - Nonroof				1		Standard Practice
SSc7.1	Heat Island Effect - Roof				1		Standard Practice - Reduces Energy use by reducing cooling loads
SSc8	Light Pollution Reduction			1		Cal-Green Building code requirement for outdoor lighting	
Water Efficiency = 6				**6**	**1**		
WEp1	Water Use Reduction, 20%		-	Y		Cal-Green Building Code	

Part B. OVERARCHING PRINCIPLES & PRACTICES

B.1 INTEGRATED APPROACH

What Is Required

Each project team performing work for SF State, with the exception of those working on minor projects, will adopt an integrated design and delivery (ID+D) process.[1] On new construction and major renovations projects, ID+D will be implemented no later than the beginning of concept design and as part of a feasibility and programming study for any major capital project. They will be pursued consistently throughout the project's entire duration – planning, design, approvals, construction, and commissioning.

ID+D enables team members to contribute their utmost expertise, insight, and experience, thus fostering the exceptional project team performance required to achieve exceptional project goals.

Figure B1. Collaborative Professional Practice Design and Construction Timeline

[1] "Integrated" and "integrative" are virtually synonymous; "integrated" is the principal term used herein to describe both.

How to Accomplish

The prime design consultant ("prime") on each project is responsible for assembling a project team with the requisite body of expertise, and ensuring effective team collaboration, open channels of communication and partnering through the design and construction process. One team member will be designated a Sustainability Champion to facilitate and coordinate collaboration.

During each project phase, the prime will submit to SF State a brief written summary of ID+D activities undertaken and outcomes resulting from those activities, along with associated deliverables.

The ID+D approach is most successful when pursued within specific contractual frameworks that share responsibilities and liabilities among the owner, architect, and general contractor. Thus, the prime is encouraged to consider adoption of such a contractual structure.

The required ID+D participants and deliverables will be as defined by the applicable credits, listed below.

In addition, SF State suggests participating firms and all major sub-consultants assign a sustainability point person, whose responsibility it is to oversee compliance with the SDF.

Relevant Credits:

- LEED v4 NC: BD+C – "Integrative Process" Option 4
- LEED v4 NC: BD+C – "Integrative Planning & Delivery" (while this credit may only be earned as part of a LEED rating on a healthcare facility, it is nevertheless a performance requirement)
- LEED v4 NC: BD+C – "LEED AP"
- LEED v4 NC: BD+C – "Tenant Design & Construction Guidelines"

Resources:

- *An Architect's Guide to Integrating Energy Modeling in the Design Process* – http://www.aia.org/practicing/AIAB097932
- *Improving Green Building Construction in North America: Guide to Integrated Design and Delivery* – http://www.cec.org/resources/improving-green-building-construction-north-america-guide-integrated-design-and-delivery
- *Sustainability Guide* (AIA Document D503-2013) – http://acdpages.aia.org/sustainabilityguide.html
- AIA Integrated Project Delivery (IPD) Family – http://www.aia.org/contractdocs/referencematerial/aiab099123

- *Comparison of IPD Agreements*, Hanson Bridgett LLP – http://www.hansonbridgett.com/Practices-Industries/construction/~/media/Files/Publications/IPD_Contract_Comparison.pdf

B.2 COMMUNITY ENGAGEMENT

What Is Required

All campus development efforts should both engage with as many constituents within the campus community as possible, and strengthen connections between SF State and our San Francisco neighbors.

How to Accomplish

Conduct activities to support these aims, including public meetings, forums, and charrettes to educate members of the campus community and the public about SF State's sustainable campus and building performance agenda, and to solicit and document their input on proposed projects.

Establish means for communication with the community throughout the design and construction phases and, in cases where the developer maintains any control, after construction.

Use architectural and aesthetic features to reinforce neighborhood identity.

ENGAGE. *Key strategies in crafting engaging spaces include harnessing the site's history and drawing in diverse community members.*

Relevant Credits:

- LEED v4 NC: BD+C – "Innovation: Community Outreach and Involvement"
- SITES v2 – "Engage Users and Stakeholders"
- SITES v2 – "Promote Equitable Site Use"

Resources:

- SF Planning Sustainable Development **–** http://sf-planning.org/sustainable-development
- Central Soma Eco-District Task Force Recommendations (Document) – http://208.121.200.84/ftp/files/plans-and-programs/emerging_issues/sustainable-development/CentralSoMa_EcoDTaskForceReport_112513.pdf

- National Charrette Institute – http://www.charretteinstitute.org
- AIA Sustainable Design Assessment Teams (SDAT) – http://www.aia.org/about/initiatives/aias075425
- International Partnering Institute (IPI) – https://partneringinstitute.org
- Eco-Districts – http://ecodistricts.org
- Sustainable Performance Institute – http://www.sustainable-performance.org

B.3 LONG ASSET LIFE

What Is Required

University projects are long-term investments; as such, all facilities will be designed for long asset life. This entails, in addition to meeting present needs, foresight as to future demands and stresses – both programmatic and contextual.

Projects must also anticipate changing needs resulting from climate change – increasing warm-season temperatures, weather instability, sea level rise, and other climate-related risks. These include increasing concentrations of air pollutants, with consequent risks to human respiratory health, as well as to the vitality of campus tree cover canopy and plantings.

How to Accomplish

Buildings must adapt to changing enrollments and curricula and thus will be designed to accommodate the potential for shifting uses over time, including shared use by different University units.

Perform life-cycle costing analysis for all major decisions affecting HVAC, enclosure, structure, infrastructure and having sustainability implications.

Take potential climate-related changes into account in designs for ventilation, cooling, and landscape schemes. Address ground-level moisture issues.

Relevant Credits:

- LEED v4 NC: BD+C – "Innovation: Design for Flexibility"
- Parksmart 1.0 – "Design for Durability"
- SITES v2 – "Design for Adaptability and Disassembly"

- LCC – “Resilient Community Connections”

Resources:

- San Francisco Climate Action Plan (0 50 100 Roots) – http://www.sfclimateaction.org
- Sea Level Rise Action Plan – http://sf-planning.org/sea-level-rise-action-plan
- Carbon Leadership Forum – http://www.carbonleadershipforum.org
- REDi Rating System (Resilient Design) – http://publications.arup.com/publications/r/redi_rating_system
- 2030 Challenge for Products **–** http://architecture2030.org/2030_challenges/products/
- San Francisco Municipal Carbon footprint – http://sfenvironment.org/article/city-government-climate-action-city-department-climate-action-plans/municipal-carbon-footprint

B.4 SITE ASSESSMENT

What Is Required

Each project team – whether developing buildings, landscape, or infrastructure – should begin by conducting an assessment of conditions at the site to be developed.

How to Accomplish

Investigate and document the microclimate, topology, hydrology, species of flora and fauna, potential hazards, and other relevant site conditions. Some of the required information may be available from SF State – consult with staff to identify relevant resources.

Relevant Credits:

- LEED v4 NC: BD+C – “Site Assessment” ✪
- LEED v4 NC: BD+C – “Environmental Site Assessment”
- LEED v4 NC: BD+C – “Sensitive Land Protection” ✪

Resources:

- San Francisco Site Mitigation and Assessment Programs – https://www.sfdph.org/dph/EH/HazWaste/hazWasteSiteMitigation.asp
- Environmental Site Assessment Projects in the SF Bay Area – http://www.eras.biz/bay_area_site_assessments.html

Part C. CAMPUS-WIDE DESIGN PRINCIPLES

C.1 URBAN DESIGN

What Is Required

A long-term goal for the University is to develop the campus as a model sustainable urban environment. Thus project teams are charged with incorporating not just urban amenities but also elements of beauty, community, nature, connectivity, and refuge. In addition, all development efforts should create more seamless, integrated connections both among campus facilities, and between the adjacent San Francisco neighborhoods and the campus, while maximizing pedestrian comfort and safety.

How to Accomplish

Lower stories of buildings will have engaging ground-level design and active uses on ground floors. Place emphasis on street/pathway design orientation; locate entrances to be easily accessible from sidewalks.

Fig C1. New development will be oriented to maximize activity on street level

(Image credit: Populous & HNTB)

Design façades to frame the street, create visual interest, and enhance diversity of the built environment. Façade heights should be complementary to widths of interstitial spaces and to heights of nearby façades. Evaluate the following elements for articulation: building materials, transparency, special ground-floor design treatments, façade modulation, corner treatments, and building setbacks for upper stories, among others.

Create and enhance street-level green spaces easily accessible by the public, including small spaces for private conversation, reading, or making phone calls; nodes – public spaces central to circulation and/or sightlines which stand as their own "place;" and recreational open spaces, such as lawns and sport fields.

Incorporate public art in prominent locations on the campus; integrate art pieces with the architecture.

Relevant Credits:

- LEED v4 NC: BD+C – "Open Space"
- LEED ND – "Compact Development"
- LEED ND – "Walkable Streets"
- LEED ND – "Connected and Open Community"
- LEED ND – "Tree-Lined and Shaded Streetscapes"
- LBC – "Human Scale and Humane Places"
- LBC – "Universal Access to Nature and Place"
- LCC – "Beauty & Spirit"
- LEED v4 NC: BD+C – "Surrounding Density and Diverse Uses" ✪
- LEED v4 NC: BD+C – "Access to Quality Transit" ✪

Resources:

- Congress for New Urbanism (CNU) – https://www.cnu.org
- National Town Builders Association – http://ntba.net
- National Planning Association – https://www.planning.org

C.2 WATER INFRASTRUCTURE

What Is Required

Reduce to the greatest feasible extent the University's reliance on municipal potable water for all uses.

How to Accomplish

Provide onsite treatment for 100% of anticipated black and grey water volume.

Use treated black/greywater for all non-potable uses (toilets, urinals, cooling towers, irrigation).

Keep irrigation plumbing separate from buildings' plumbing systems.

Relevant Credits:

- LEED ND – "Wastewater Management"
- LEED v4 NC BD+C – "Outdoor Water Use Reduction" ✪ (achieve 2 points plus Regional Priority point)
- LBC – "Net Positive Water"
- LCC – "Net Positive Water"

Resources:

- San Francisco Public Utilities Commission Non-Potable Water Program – http://sfwater.org/index.aspx?page=686

  District Scale Water Calculator – http://sfwater.org/modules/showdocument.aspx?documentid=5233

- Innovation in Urban Water Systems – http://sfwater.org/index.aspx?page=836
- National Blue Ribbon Commission, US Water Alliance – http://uswateralliance.org/news/us-water-alliance-and-san-francisco-public-utilities-commission-announce-joint-commitment-white
- Water Environment Research Foundation (WERF) – www.werf.org/
- *Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment* – http://living-future.org/ilfi/ideas-action/research/water/toward-net-zero-water

C.3 ENERGY INFRASTRUCTURE

What Is Required

Clean, carbon-free energy supply and energy supply stability are critical elements of the University's Climate Action Plan. Thus project teams are required to work towards development of infrastructure so as to make the campus energy self-sufficient, while remaining tied to the power grid.

How to Accomplish

Develop onsite renewable energy generation facilities, heat recovery and transfer mechanisms (e.g., wastewater heat recovery), and energy storage, adequate to allow the campus to meet its own energy needs on an annual basis.

Ensure that facilities incorporate means of ensuring reliable electric power, addressing power interruptions, and transitioning to and from backup energy sources when necessary.

Protect against energy waste due to events such as recovering from power outages, tree trimming, substation maintenance, etc.

Incorporate measures designed to protect against equipment failures.

Provide demand response capabilities – e.g., onsite energy generation, onsite energy storage, and load shedding during peak demand periods in response to 'calls' from utility companies.

Provide real-time energy usage data to campus energy managers to encourage hands-on energy management.

Relevant Credits:

- PEER – "Islanding Capability"
- PEER – "SCADA (Supervisory Control and Data Acquisition)"
- PEER – "Source Energy Intensity"
- PEER – "Waste Identification & Elimination"
- PEER – "Failure Identification and Elimination"
- PEER – "Demand Response Capability"
- PEER – "Access to Real-time Data"
- PEER – remainder of criteria; the above are the most critical for consideration

Resources:

- SF Environment – Energy – http://sfenvironment.org/energy

- Energy from Wastewater – http://www.huber-technology.com/products/energy-from-wastewater.html
- Solutions for Wastewater Heat Recovery from Sewers – http://www.huber-technology.com/solutions/heating-and-cooling-with-wastewater.html

C.4 LANDSCAPE

What Is Required

SF State's landscape is an important aspect of the campus experience. The vibrancy of a campus community depends on its ability to meet, interact, and navigate on foot. Thus, project teams will create walkable urban spaces, integrating new development with surrounding facilities and neighborhoods.

Project teams will preserve and enhance all landscape elements within their control, including soil, plantings, hardscape, and site equipment.

Teams also will manage onsite all stormwater from a 99th-percentile weather event, including the runoff from any adjoining unmanaged space, such as a parking lot or street.

> ***RAIN WATER*** *is an important natural resource that has long been mismanaged. Dumping rain water into storm drains short-circuits nature's way of replenishing the water table. It also overloads municipal infrastructure, causes stream sedimentation, and introduces pollutants into waterways.*

How to Accomplish

Maximize effective street connections for pedestrians, and incorporate convenient and inviting pathways to surrounding areas. Decrease the impact of the site's predominantly westerly winds, to the extent possible, by orienting thoroughfares north-south. Enhance pedestrian view corridors.

Incorporate diverse vegetation types and species into planting plans to provide year-round visual and olfactory interest. Consider opportunities to include community gardens and/or urban food production throughout the campus. Implement all opportunities for habitat protection and/or restoration. Minimize use of turf and where used, select only drought-tolerant species.

Wherever possible, select hardscape surfaces that are permeable and will enhance the visual dynamism of the campus; consider alternatives such as brick, stone, or other paving options.

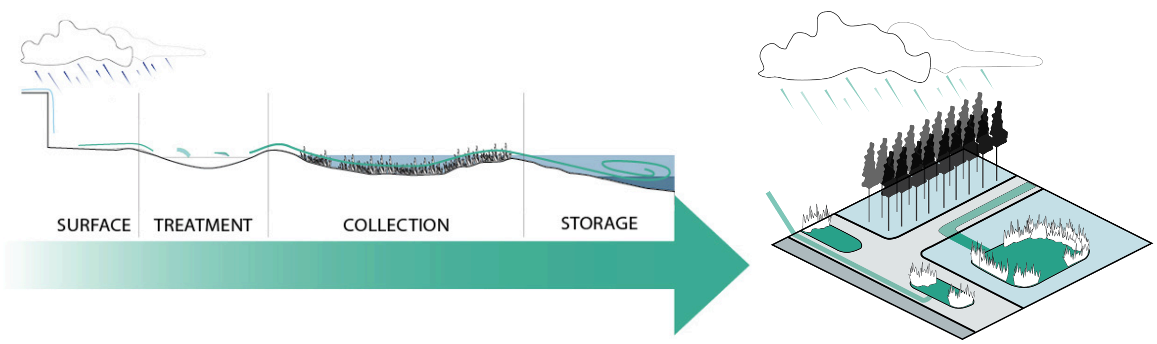
Incorporate attractive, comfortable, and durable site equipment designed to foster informal socializing as well as recreational activities.

Maximize use of green infrastructure (GI) and low-impact development (LID) approaches across the campus to integrate site developments with surrounding conditions. GI and LID features should be designed as aesthetic complements to landscape and streetscape features, in addition to providing stormwater management functionality. Implementation of stormwater detention techniques will be a priority across the SF State campus.

Refer to the *SF State Landscape Framework / Forest Management Plan* for specific guidance.

Fig C2. Sustainable Stormwater Management Approaches

(Image credit: [to come])



Relevant Credits:

- LEED v4 NC: BD+C – "Open Space"
- LEED v4 NC: BD+C – "Heat Island Reduction" (Non-roof Measures)
- SITES v2 – "Manage Precipitation Beyond Baseline"
- SITES v2 – "Use Appropriate Plants"
- SITES v2 – "Conserve and Restore Native Plant Communities" (achieve 6 points)
- LEED ND – "Steep Slope Protection"
- SITES v2 – "Restore Soils Disturbed During Construction"
- LEED v4 NC: BD+C – "Light Pollution Reduction" ✪

Resources:

- Add GI & LID references
- San Francisco Green Landscaping Ordinance & Bike Parking – http://sfenvironment.org/article/other-local-sustainable-buildings-policies/green-landscape-ordinance-and-bicycle-parking

- Bay-Friendly Landscape Guidelines: Sustainable Practices for the Landscape Professional – http://www.stopwaste.org/bayfriendlyrated and http://www.stopwaste.org/resource/brochures/bay-friendly-landscape-guidelines-sustainable-practices-landscape-professional

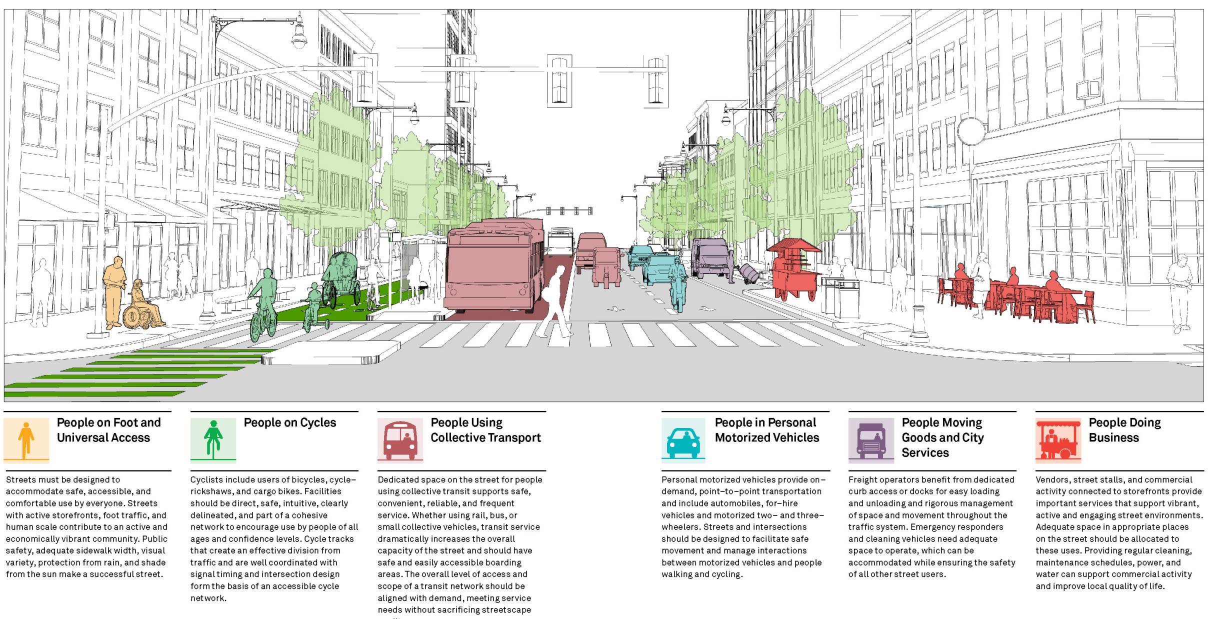
C.5 TRANSPORTATION

What Is Required

SF State's Climate Action Plan goals include dramatically reducing the carbon emissions due to campus-associated transportation. Thus all designs should prioritize walking, biking, and mass transit over private automobiles, with emphasis placed on multi-modal streets, creating safe and welcoming places for pedestrians and bicyclists across the campus. Walking is addressed in Section C.4.

Fig C3. Multi-modal Street Design Principles

(Image credit: [to come])



How to Accomplish

Design projects to facilitate the creation of a comprehensive, safe and effective campus-wide bicycle network and to provide convenient access to as many mass transit options as possible.

The bicycle network should comprise continuous off-street paths, dedicated on-street lanes, and/or low-speed streets. Additionally, it should connect to all transit stops serving the campus.

Provide secure, user-friendly bicycle parking facilities that will accommodate both current and projected future volume, in locations convenient to transit stops and heavily-used campus facilities. Provide both uncovered short-term and covered long-term bicycle parking options, as well as secure bike parking alternatives. Design auto parking garages to allow conversion of car parking spaces to bicycle parking.

In each building, provide a shower in a gender-neutral, ground-floor restroom, with adjacent lockers.

Control motor vehicle traffic by incorporating clear, unobstructed signage before, and upon, drivers' arrival to a decision point. Utilize speed controls, such as rumble strips and speed bumps, to enhance safety.

Give right-of-way to pedestrians and bicyclists via motion-sensitive bike and pedestrian alert signals.

Design auto parking facilities to accommodate and encourage alternative-fuel ("green") vehicles.

Relevant Credits:

- LEED v4 NC: BD+C – "Bicycle Facilities" ✪
- Parksmart – "Bicycle Parking"
- LEED ND – "Bicycle Facilities"
- City and County of San Francisco Planning Code – Sections 155.2-155.5 and Zoning Administrator Bulletin No. 9
- SITES – "Encourage Fuel-efficient and Multi-modal Transportation" (achieve 4 points)
- City and County of San Francisco Planning Code – Sections 150-155
- LEED v4 NC: BD+C – "Reduced Parking Footprint" ✪
- LEED v4 NC: BD+C – "Heat Island Reduction (75%+ Covered Parking)"
- Parksmart – "Shared Parking"
- LEED v4 NC: BD+C – "Green Vehicles" ✪
- Parksmart – "EV Charging" (achieve 6 points)
- Parksmart – "Low-Emitting & Fuel-Efficient Vehicles" (achieve 2 points)
- Parksmart – "Alternative Fuel Vehicles" (achieve 3 points)

Resources:

- City and County of San Francisco Department of the Environment, Transportation – http://sfenvironment.org/transportation

- Parksmart – http://parksmart.gbci.org

Part D. BUILDING DESIGN PRINCIPLES

D.1 ENERGY PERFORMANCE

What Is Required

Every major project will achieve a level of energy efficiency commensurate with the University's campus-wide goal of achieving zero net energy (ZNE) or net-positive energy.[1] Target energy use intensities (EUIs) for new facilities and major retrofits, by building type, are shown in Table D1.

Table D1. Maximum Energy Use Intensities by Building Type

(Source: ARUP, 2012)

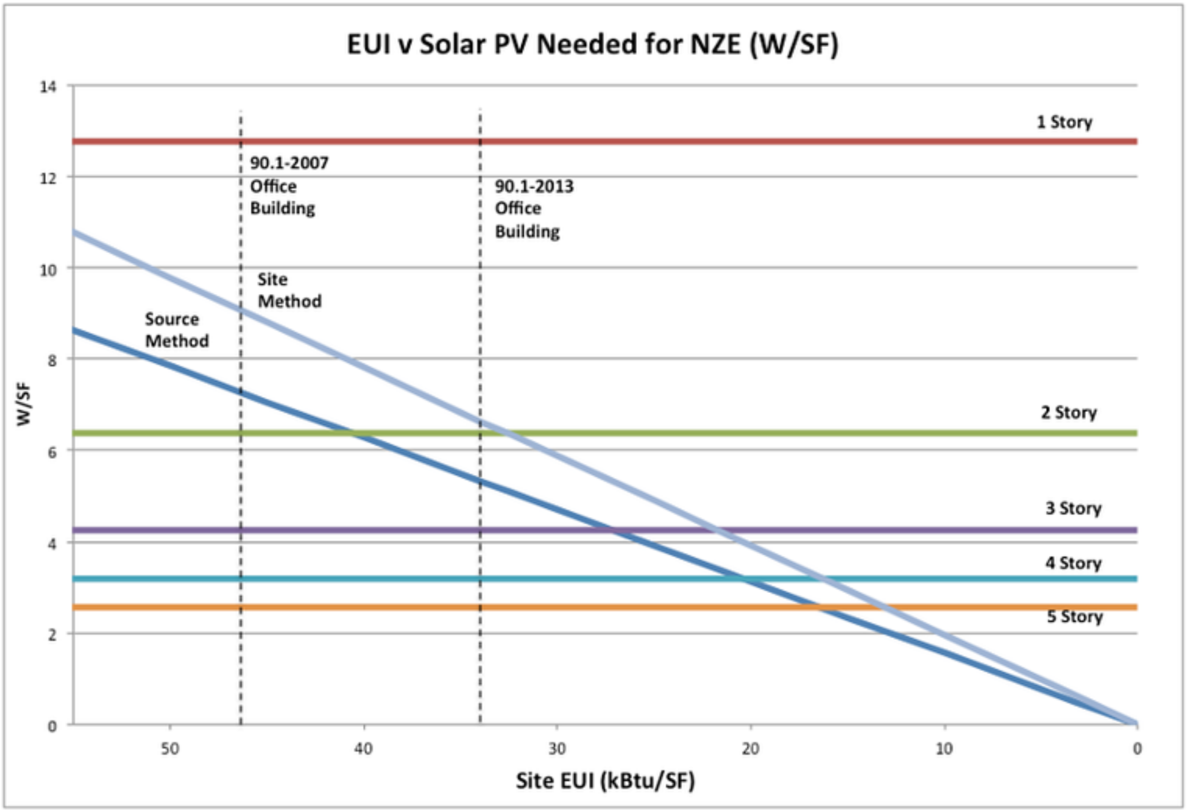
Building Type	**Maximum EUI** (kBtu/sf/yr)
Residential	15
Retail	25
Dining	200
Academic	40
Office	14-17
Lab	*TBD**
Recreation	*TBD**
Assembly	*TBD**

* EUI to be determined based on best practices at the time design is initiated, by consulting authoritative resources such as those listed herein. In general, SF State expects all EUI standards to be updated as new research and guidance is published.

WHY ZNE MATTERS. *In order for the University to achieve its overall carbon reduction goals, all major construction projects at a minimum will need to meet their own operating energy needs with onsite renewable energy, and ideally will produce a surplus of carbon-free energy to help offset operations of existing campus facilities that are not able to achieve ZNE. See Figure D1.*

[1] A net-positive energy building produces more renewable energy each year than the building itself uses.

Figure D1. Maximum Energy Use Intensities by Building Type (watts/square foot)
(Image credit: Joshua Radoff)



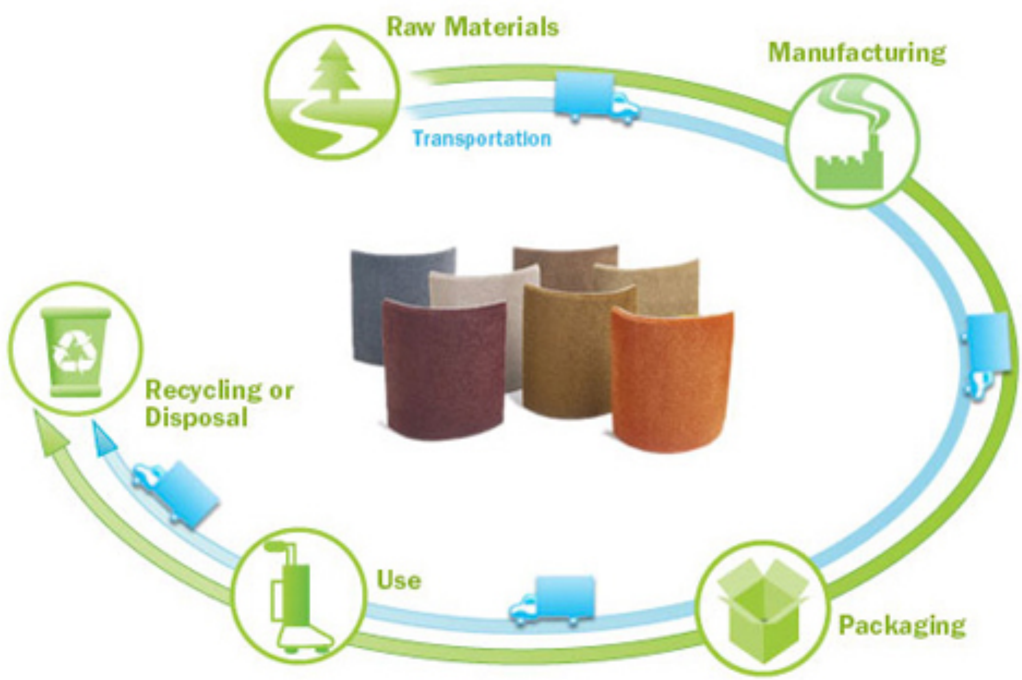
How to Accomplish

Project teams will read the most current edition of the University's Climate Action Plan and demonstrate how their building designs will fulfill the carbon reduction goals described therein.

The major building systems that influence energy efficiency are shown in Figure D2, along with key design principles for each. However, because overall energy performance is a function of effective integration among these systems, these are merely guidelines; the *whole* design will be optimized via an integrated approach that is based upon a life-cycle cost and impact approach. See Section B1 for more information.

Perform early energy modeling to evaluate the impact of three or more building massing/geometry options on EUI. Conduct life-cycle analysis (LCA) during each major design phase (concept, schematic, and design development) to inform balanced decisions about operating energy and embodied carbon.

Figure D2. Life cycle analysis assesses the cost of a new development from the price of raw materials all the way to the recycling and/or disposal process
(Image credit: xxx)



Relevant Credits:

- LEED v4 NC BD+C – "Minimum Energy Performance"
- LEED v4 NC BD+C – "Optimize Energy Performance"
- LEED v4 NC BD+C – "Heat Island Reduction" (Vegetated Roof/SRI)
- LEED v4 NC BD+C – "Enhanced Refrigerant Management" ✪
- LEED v4 NC BD+C – "Advanced Energy Metering"
- LEED v4 NC BD+C – "Light Pollution Reduction" ✪

Resources:

- New Buildings Institute Getting to Zero Database
  http://newbuildings.org/resource/getting-to-zero-database/
- Sefaira early energy simulation software
  http://sefaira.com/sefaira-architecture/
- Passive House design criteria and tools

- *The Technical Feasibility of Zero Net Energy Building in California*, ARUP, 2012 – http://www.energydataweb.com/cpucfiles/pdadocs/904/california_zne_technical_feasibility_report_final.pdf
- *Liberty Lighting Guidelines for Zero Net Energy Communities* http://cltc.ucdavis.edu/publication/liberty-lighting-guidelines-zne-communities
- ACEEE.org
- Enervee.org

Figure D3. Energy Efficiency Checklist

Envelope	✓ Choose glazing ratio to optimize daylighting and thermal gains/losses
	✓ Ensure continuity of air, thermal, and moisture barriers throughout enclosure
	✓ Incorporate high levels of insulation and ensure quality installation via onsite inspection
	✓ Establish target air leakage rate
	✓ Develop air-sealing details for all building intersections and ensure quality installation via onsite inspection and air leakage testing
	✓ Specify high-performance glazing (appropriate U, SHGC, and VT; dynamic glazing as appropriate)
	✓ Incorporate shading strategies to minimize or eliminate cooling loads wherever possible
	✓ Select exterior materials to minimize contribution to urban heat island effect
Space heating & cooling	✓ Determine optimum overall comfort strategies, including passive and renewable approaches *as appropriate* (e.g., solar water heating, ground-source heat pumps, etc.)
	✓ Exploit heat-recovery strategies wherever possible (e.g., heat-recovery ventilation, drain water heat recovery, etc.)
	✓ Design high-performance systems
	✓ Specify equipment that is efficient and will operate defect-free with routine maintenance that can be performed by University staff and/or contractors
	✓ Ensure quality installation via onsite inspection, performance testing (duct leakage, air flows, etc.), and other commissioning activities
Water heating	✓ Determine optimum overall water heating strategies, including passive and renewable approaches *as appropriate* (e.g., solar water heating, ground-source heat pumps, etc.)
	✓ Design high-performance systems
	✓ Specify high-quality, durable, low-flow/low-flush fixtures
	✓ Specify equipment that is efficient and will operate defect-free with routine maintenance that can be performed by University staff and/or contractors
	✓ Ensure quality installation via onsite inspection, performance testing, and other commissioning activities
Electric loads	✓ Establish lighting power densities based on best practices for each type of use. Include occupant-controlled light switches with dimming capability, as well as motion/vacancy/daylight sensors to shut lights off when they are not needed.
	✓ Specify LED fixtures for all appropriate applications.
	✓ Specify best-in-class energy-efficient appliances, cooking, & other loads

D.2 RENEWABLE ENERGY

What Is Required

Project teams will incorporate energy generation facilities, heat recovery and transfer mechanisms, and energy storage in new buildings and major retrofits, consistent with supporting the University's goal of campus-wide energy self-sufficiency (see Section C3).

How to Accomplish

Design buildings with roofs that are flat, south-facing, or west-facing to ensure optimal solar exposure. Maximize opportunities for solar applications by avoiding roof penetrations and consolidating those needed within as small an area as possible. Do not shade other rooftops.

Consider the life-cycle economics – in both monetary and energy terms – in selecting types of energy systems to include in a building. Incorporate photovoltaics and/or solar hot water systems on building rooftops and/or façades, as needed, to optimize onsite energy production.

On buildings where solar arrays will not be installed, ensure that the structures are adequate to support later installation of solar panels.

Relevant Credits:

- LEED v4 NC BD+C – "Renewable Energy Production"

Resources:

- San Francisco Mayor's Renewable Energy Task Force Recommendations Report – http://sfenvironment.org/download/san-francisco-mayors-renewable-energy-task-force-recommendations-report

San Francisco Better Roofs Ordinance – http://sfenvironment.org/policy/resolution-in-support-of-better-roof-requirements-for-renewable-energy-facilities-ordinance-file-number-160154

D.3 OCCUPANT WELL-BEING

What Is Required

Project teams will develop facilities that protect and enhance occupants' well-being by addressing air and water quality, acoustic comfort, and biophilia.

BIOPHILIA: *Biophilic design is a sustainable design strategy of connecting people with the natural environment.*

How to Accomplish

Design building enclosures with climate-appropriate vapor profiles and continuous air, thermal, and moisture barriers. Include robust quality management measures in construction specifications.

Include fresh-air ventilation supply and direct source exhaust ventilation systems designed to mitigate all air quality risks inherent to the building location and uses.

Provide for acoustic separation in residential buildings, study spaces, faculty offices, conference rooms, science labs, and facilities with other specific acoustic needs.

Employ biophilic design principles and elements in building design – e.g., ample daylight, organic shapes and forms, natural elements such as plants.

Conduct post-occupancy evaluations for all facilities to identify any user satisfaction concerns. First evaluations should occur before end of warranty period and every one to two years following.

Relevant Credits:

- WELL – "Air Infiltration Management" [include or not TBD]
- WELL – "Direct Source Ventilation"
- WELL – "Advanced Air Purification" [include or not TBD]
- LEED v4 NC BD+C – "Environmental Tobacco Smoke Control"
- LEED v4 NC BD+C – "Quality Acoustics"
- LBC – "Biophilic Environment"
- WELL – "Water Filtration" (Features 30-37) [may be unnecessary, given good SF water?]
- LEED v4 O+M – "Occupant Comfort Survey"

Resources:

- Building Science Corporation – www.buildingscience.com
- WUFI simulation software – https://wufi.de/en/

D.4 MATERIALS

What Is Required

Design projects to incorporate materials of construction for minimal adverse environmental impacts and minimal risks to human health.

How to Accomplish

Specify materials that are environmentally preferable, healthy, and can be supplied with credible documentation as to sourcing and ingredients.

Minimize the embodied carbon footprint of the building and related construction activities; support this objective by including locally-manufactured products and employing life-cycle analysis.

CONSIDER WOOD: *Wood structures are typically lower in embodied carbon than concrete & steel. Cross-laminated timber (CLT) makes building with wood possible even for high-rise buildings.*

Relevant Credits:

- LEED v4 NC BD+C – "Low-Emitting Materials" (achieve 3 points)
- LEED v4 NC BD+C – "Environmental Product Declarations (EPDs)," Option 1 (use 20 products with EPDs)
- LEED v4 NC BD+C – "Material Ingredients," Option 1 (material ingredient reports, 20 products)
- LEED v4 NC BD+C – "Building Life Cycle Impact Reduction," Option 4 (whole-building LCA)
- LBC – "Materials Red List"
- LBC – "Embodied Carbon Footprint"
- LBC – "Responsible Industry"
- LBC – "Living Economy Sourcing"
- LBC – "Net Positive Waste"
- LEED v4 NC BD+C – "Storage and Collection of Recyclables"

Resources:

- Cross-laminated Timber (CLT) – http://www.apawood.org/cross-laminated-timber

D.5 WATER

What Is Required

Reduce to the greatest feasible extent each building's demand for potable water.

How to Accomplish

Create a water budget for the building during concept design.

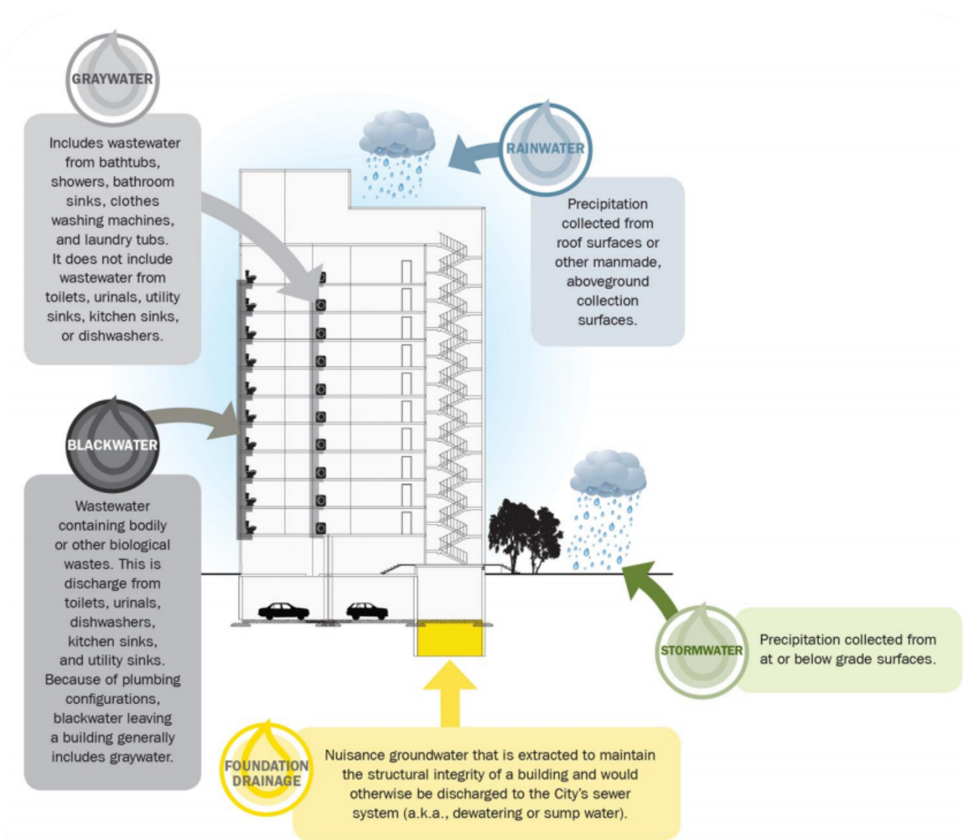
Provide onsite treatment for 100% of anticipated black and grey water volume.

Use treated black/grey water for all non-potable uses (toilets, urinals, cooling towers, irrigation).

Design efficient distribution systems and provide low-volume fixtures.

If the project includes landscaping, refer also to Sections C2 and C4 of this Framework, and to the *SF State Landscape Framework* for specific guidance.

Figure D4. Building Water Reuse Strategies



Relevant Credits:

- LEED v4 NC BD+C – "Indoor Water Use Reduction" (achieve 6 points plus exemplary performance and Regional Priority points)
- LEED v4 NC BD+C – "Cooling Tower Water Use" ✪
- LEED v4 NC BD+C – "Outdoor Water Use Reduction" ✪ (achieve 2 points plus Regional Priority point)
- LEED v4 NC BD+C – "Water Metering" ✪
- Parksmart – "Greywater Reuse" (achieve 2 points)

Resources:

- San Francisco Public Utilities Commission Non-Potable Water Program – http://sfwater.org/index.aspx?page=686

  SFPUC Non-Potable Program Guidebook – http://sfwater.org/modules/showdocument.aspx?documentid=4962

  Non-Potable Water Ordinance – http://sfwater.org/modules/showdocument.aspx?documentid=7467]

  Building Scale Water Calculator – http://sfwater.org/modules/showdocument.aspx?documentid=5234

Part E. CONSTRUCTION & COMMISSIONING PRACTICES

E.1 CONSTRUCTION WASTE & POLLUTION PREVENTION

What Is Required

Consistent with the University's goal of zero waste, every project will minimize the generation of waste and pollution of all kinds via comprehensive construction waste and pollution prevention programs.

How to Accomplish

Employ precise ordering practices, ordering no more than is necessary of any given item.

Provide onsite reuse facilities for material off-cuts and other materials that have reuse potential.

Site-separate different types of waste and obtain the highest locally achievable rate of diversion for each type of material.

Compost green waste and other organics.

Document and report all diversion and disposal activities to the University.

Relevant Credits:

- LEED v4 NC BD+C – "Construction IAQ Management Plan"
- LEED v4 NC BD+C – "Construction Activity Pollution Prevention"
- LEED v4 NC BD+C – "Construction and Demolition Waste Management"
- SITES – "Control and Retain Construction Pollutants" (prerequisite)
- SITES – "Divert Reusable Vegetation, Rocks & Soil from Disposal" (achieve 3 points)
- SITES – "Recycle Organic Matter"

Resources:

- California Commissioning Collaborative – http://www.cacx.org/index.html
- How to Comply and Report to SF Environment – http://sfenvironment.org/article/energy-efficiency-audits/how-to-comply-and-report-to-sf-environment

- Minimum Qualifications for Energy Auditors – http://sfenvironment.org/article/energy-efficiency-audits/minimum-qualifications-for-energy-auditors

E.2 COMMISSIONING

What Is Required

In order to support the University's Climate Action Plan goals, all buildings and systems will be built and commissioned to operate at the highest possible efficiency and provide the longest possible effective service life.

How to Accomplish

Implement a rigorous quality management program throughout construction, including performing diagnostics appropriate for the particular building.

For residential projects, ensure compliance with California's Quality Insulation Installation (QII) protocol and EPA's Energy Star standards, including Thermal Bypass Inspection.

Fully commission all systems.

Relevant Credits:

- LEED v4 NC BD+C – "Enhanced Commissioning" (achieve 6 points)

Resources:

- 2013 Building Energy Efficiency Standards Reference Ace, *Quality Insulation Installation Procedures* – http://energycodeace.com/site/custom/public/reference-ace-2013/index.html#!Documents/ra35qualityinsulationinstallationprocedures.htm
- ENERGY STAR Certified Homes Version 3 Program Requirements – https://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_v3_guidelines

QUALITY MATTERS. *Installation quality defects in insulation and mechanical systems can account for efficiency losses of 50% or more. Quality management programs and use of diagnostics during construction – such as infrared imaging, blower door testing, and duct pressure testing -- can dramatically reduce these losses.*