The Sustainable Design Guidelines are the product of the ASU Office of the University Architect with the support and participation of the Sustainable Design Advisory Committee.

Arizona State University
Sustainable Design Guidelines

The ASU Sustainable Design Guidelines have been created to assist in advancing sustainable design on all Arizona State University campuses. The guidelines are intended to be applied to new construction and major renovation[1] projects. Design Professionals, Contractors, and third party Developers of ASU projects shall be required to incorporate the guidelines into their projects. The goal is to meet as many of the guideline objectives as possible.

Projects shall be submitted to the Sustainable Design Advisory Committee (SDAC) (submit to the SDAC coordinator) by the ASU project manager as early as possible, preferably during concept development but no later than the mid-point of the schematic design phase. The SDAC will hold regularly scheduled meetings, but may call special meetings as needed depending on project schedule requirements.

The SDAC will review all projects for compliance with the guidelines. Deviations shall be identified by the project team for review and discussion with the SDAC. Where applicable, a Return on Investment (ROI) analysis may be required, to include environmental, economic and social costs and benefits. Project teams are encouraged to submit a ROI analysis with their initial review package for any proposed design elements with an initial first cost greater than a conventional solution.

SDAC review will be concurrent with the design process and should not impact the project schedule, depending on the level of compliance or deviation and timely ROI submissions, when required. Following the above review, analysis and negotiation, the SDAC will provide a summary report to the CFO and request direction on any unresolved guideline items. In addition, the project team shall provide the following items:

- Modified response to the Sustainable Design Guidelines which addresses the SDAC review comments and indicates changes in the design.
- Simple, bulleted list of the sustainable design features (upon completion of construction documents)
- One-year post occupancy report (indicating how sustainable design goals have or have not been met; what worked and what didn't work; hindsight evaluation - what would you do differently, etc.)

The ability to achieve ASU's sustainability goals as delineated in the guidelines shall be a significant factor in the selection of Design Professionals, Contractors and Developers for ASU work.

Sustainable Design Guidelines
New Construction & Major Renovation

A. Programming & Design

A1. Innovation and Creativity: Innovation and creativity in achieving the sustainable design goals are encouraged. Additionally, design aesthetics shall be considering in all aspects of the building design, including sustainable design components. The State of Arizona mandate for all state facilities to achieve LEED[2] Silver certification is the minimum standard for ASU. ASU's goal is to excel in sustainable design in as many ways as possible.

A2. General Project Planning & Design: The design shall manifest the ASU commitment to sustainability to the greatest extent possible. Sustainability shall be addressed comprehensively as an integral aspect of the design philosophy and in all aspects of the building design.

A3. Building Size & Footprint: Minimize the overall building size (square footage and footprint) while meeting the building program requirements. The goal is efficient use of space to reduce overall resource consumption; including embodied energy, operational energy, and building materials.

A4. Design for Future Use: Plan for a "100-year Building" through flexibility of use and future reuse; no "throw away" buildings. Design interior spaces that are flexible and allow for changes in use. Use standard furniture wherever possible. Minimize use of custom millwork, custom building systems (door frames, doors, interior windows etc.) to maximize reuse in the future. For retrofits, analyze current space requirements for space efficiency, function, and use proximity.

A5. Programming & Space Planning: Group spaces or activities with similar energy requirements and times of use to allow for zoning efficiency of passive and mechanical energy systems. The goal is to reduce demand and optimize operational efficiency.

A6. Service Areas: Service areas shall support efficient operations, program, and building management for ASU sustainability initiatives; such as recycling collection, trash compaction, water capture, service vehicle access, etc.

A7. Transition spaces: Provide sufficient exterior screening, transition courtyards, exterior atrium spaces, shade trellises, etc., to allow the building occupant the opportunity for eye adjustment from bright to low light and from low to bright light.

A8. User Involvement: Survey building occupants/users for sustainable design, maintenance and operations suggestions; utilize the recommendations in the design as practicable.

A9. Building Commissioning: Provide "enhanced" building commissioning as specified by the LEED Green Building Rating System to insure coordination of all building systems.

A10. Life Cycle Assessment (LCA) & Life Cycle Costing (LCC): 1) Provide a Life Cycle Assessment to analyze and evaluate the environmental impacts of materials, products or services proposed in the design. The goal of LCA is to compare the full range of environmental and social impacts assignable to products and services, and to choose the least environmentally detrimental alternative while meeting the project intent;

2) Provide Life Cycle Cost (LCC) data and analysis for all sustainable design features which have a higher upfront cost, but will pay back the investment over time (Return on Investment).

B. Site Planning & Development

B1. Existing Landscaping: Protect significant natural and historic landscaping and incorporate those elements into the new landscape design.

B2. New Landscaping/Site Planning: Program the site to create a "sense of place" through the design of a variety of experiences and activities with micro-climates appropriate to desert climate conditions. Maximize opportunities to create landscape shading and cooling for the building, exterior spaces, and walkways while also specifying low maintenance *and* desert-appropriate plant materials.

B3. Paved Surfaces: Utilize permeable surfaces to reduce runoff and reflective surfaces to reduce the urban heat island effect.

B4. Bicycle Parking: Provide ample bike rack space to accommodate both staff and student use of the building.

C. Energy Use & Conservation

C1. Carbon Neutrality: A zero carbon emission campus is the ASU goal.

C2. Building Envelope: Design the building envelope to minimize heat loss and gain. Exceed the current ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) building envelope performance baseline standard by 30% or more. Avoid thermal bridging by providing thermal breaks in the exterior building envelope.

C3. Energy Analysis: Prepare a projected building energy use and life cycle cost analysis. Submit the complete analysis for review by the SDAC during design development. Submit building energy use models as required for project definition, performance, and compliance (see C 10 Energy Modeling).

C4. Climate-Responsive and Passive Systems Design: Design buildings in a climate-responsive manner to reduce energy demand, maximize passive heating and cooling, and minimize mechanical HVAC requirements (through building form, orientation, articulated shading, natural ventilation, glazing, interior thermal mass, blinds, controls, geothermal energy, earth tempering, etc.)

C5. Window Glazing: Select glazing size and materials appropriate for the orientation of the windows. Use double or triple glazing wherever possible. Thermal breaks shall be included in window frames at all exterior glazing.

C6. Window Shading: Every exterior window shall be shaded appropriately for the window orientation. Consider cleaning and maintenance of windows and shading devices in the design. Provide a shading analysis for review. Insure that operable interior shading is accessible to the building occupants.

C7. On-Site Renewable Energy Generation: Incorporate solar and renewable energy systems into the building design, such as photovoltaic panels which replace other building materials such as roof and wall finishes and shading elements; and/or prepare the building to receive solar equipment (conduit stub-outs, grouping of other rooftop equipment, space for solar equipment in the building, etc.). Ensure that the building and roof are "solar ready." Investigate and propose all possible viable options for renewable energy generation.

C8. Mechanical Systems: Specify energy-efficient HVAC and electrical systems. Coordinate systems and controls with other building systems to optimize building operation and reduce energy consumption on a life-cycle basis. Provide motion sensors, daylight-responsive dimming, and electronic ventilation controls. Consider using low carbon technologies (heat pumps) or central plant system design. Consider extended life cycle maintenance and material costs in mechanical systems design. Use natural sinks for cooling (the ground or natural water bodies). Use heat recovery systems wherever possible to minimize energy usage.

C9. Energy Commissioning & Monitoring: Provide building energy commissioning beginning in schematic design to establish energy goals, and ending with a post-occupancy energy analysis. Provide permanent energy metering on all buildings for monitoring each type of energy use, utilizing the ASU Campus Metabolism[4] monitoring standards for water, lighting, other electrical, gas, etc. Provide the capability to monitor and analyze post-

occupancy performance in comparison to energy analysis predictions. Submit comparative analysis for review by the SDAC. Provide a 1-year and 2-year post occupancy energy/carbon use analysis. Use Smart Meters for all spaces or groups of spaces to monitor energy use and educate users on their affect on energy consumption.

C10. Energy Modeling: Provide energy systems modeling and use calculations for strategic design decisions, such as shading, energy use, daylighting, etc. Acceptable baselines are ASHRAE *Standard for the Design of High Performance Green Buildings* (most current adopted standards) or Green Building Initiative National Standard 01-200XP: *Green Building Assessment Protocol for Commercial Buildings* (or most current standards).

C11. Building Systems: Consider using energy saving building elements and systems like radiant cooling, chilled beams, under floor air distribution systems, etc. (under floor air distribution systems also add flexibility to spaces for retrofits).

D. Water & Wastewater

D1. Landscaping: Reduce demand on all systems. Utilize appropriate low water use desert and indigenous landscaping materials, balancing that with the creation of shaded micro-climate areas and comfortable, usable outdoor spaces. Utilize dense canopy trees for shading walkways and creating desert "oasis" areas utilizing captured water.

D2. Irrigation: Maximize the use of captured water (reclaimed, harvested rainwater , etc.) for landscape irrigation. Use irrigation cisterns for water features in lieu of continuous potable water fountains. All emitters for trees and landscape shall be designed for easy modification to reduce the amount of water used (to initially establish a desert landscape) over time to conserve water as plants become established; and to be easily modifiable to move the system farther out over time to encourage root spread.

D3. Water Capture: Provide a site location for collection opportunities for current and/or future water capture and reuse. Provide opportunities for rainwater harvesting and condensate collection.

D4. Plumbing Fixtures: All plumbing fixtures shall be certified low water use. $1/8^{th}$ gallon urinals (or similar) and dual-flush toilets shall be used whenever possible.

D5. Gray Water: Maximize gray water use for landscape irrigation and other purposes as the law allows.

D6. Landscape Maintenance: Reduce maintenance and potential problems caused by landscape debris. Specify plants appropriately for their purpose and location. Avoid

overplanting. Consider mature landscape growth potential to insure appropriate integration with lighting and other site systems.

D7. Monitoring & Metering: Provide water metering and monitoring at each building. Insure that data collection will be compatible with the ASU Campus Metabolism[4] Project. The goal is to provide metering and monitoring at each building connected to a centralized system**.** Provide separate metering for landscape irrigation and building use.

E. Construction & Finish Materials

E1. Climate-Responsive Materials: Specify materials that are durable under desert climate conditions (UV radiation exposure and extreme heat).

E2. Embodied Energy: Minimize the use of high embodied-energy materials.

E3. Reused & Repurposed Materials: Present opportunities for installation of reused and repurposed materials, including the building shell, structural materials, finishes, fixtures, etc. Utilize Green Globes[3] reference guidelines for baseline standard.

E4. Recycled-Content Materials: Present options for materials with high recycled content. Utilize Green Globes reference guidelines for baseline standard.

E5. Local/Regional Materials: Specify locally and/or regionally harvested and manufactured materials whenever possible.

E6. Rapidly Renewable Materials: Specify materials that are made from rapidly renewable materials whenever possible and practicable.

E7. Construction Waste: Minimize or eliminate construction waste. Reduce, reuse and/or recycle waste materials to minimize disposal to a landfill.

E8. Maintenance: Specify low maintenance materials. Material and building maintenance, and special cleaning procedures, shall be reviewed with ASU FACMAN (Facilities Management) in the design development phase for integration into the ASU sustainable cleaning program standards.

E9. Building Construction Supervision: Schedule on-site quality control inspections to check for/assure freedom from heat bridges.
- Assure that insulation layers are continuous, and without air pockets.
- Check joint details for air tightness while they are accessible.
- Have a building shell pressure test performed as part of the building commissioning.

F. Indoor Environmental Quality

F1. VOCs: Eliminate or minimize use of volatile organic compounds for interior finishes, cabinetry, furnishings, and other interior applications. Contractor to provide full system flush for all HVAC systems prior to start-up.

F2. Natural Daylight: Utilize natural daylight and views to enhance building occupant comfort. Provide adequate operable shading where necessary to reduce heat and glare.

F3. Occupant Control of Thermal Comfort : Provide opportunities for reasonable individual control of thermal comfort, including lighting, heat, shading, and natural ventilation within the parameters established for the space by Facilities Management. Insure that controls are such that occupants have a sense of and understand the control of their thermal and visual environment.

G. Operation & Maintenance

G1. Building "Owner's Manual": Provide a Building Owner's Manual (in digital format) on how to operate and maintain the building and site to optimize the building systems and design.

G2. Operation & Maintenance Education: Conduct a building owner/user/FACMAN workshop prior to occupancy to review the "Building Owner's Manual" and direct building users on how to optimize the building systems and design.

G3. Post-Occupancy Evaluation: Post-occupancy evaluations will be performed by the Architect/Design Professional (DP) or a consultant retained by the DP at the end of the first year of occupancy. The evaluation shall include performance and satisfaction assessments of building comfort, HVAC systems operations & controls, water and energy use, lighting, etc.

H. Building Education

H1. Resource Usage Information Display: Buildings are not static in nature and therefore it is important to provide feedback to the users on their effect on energy, water and other resource consumption as they use the buildings. Provide smart meters to educate and influence user behavior with the goal of reducing energy consumption.

H2. Interpretation: Buildings should be an educational opportunity for the users, to educate the users on energy savings and resource saving features of buildings. Provide innovative ways to educate users about the sustainable building design, through the use of signage, displays (green screen or other form) and any other appropriate communication device to explain design strategies, techniques, technologies, etc.

1 Major renovation is defined by The Arizona Board of Regents as projects over $5,000,000.

2 LEED (Leadership in Energy and Environmental Design) is the US Green Building Council green building rating system (http://www.usgbc.org/).

3 Green Globes is a green building assessment and rating system operated by the Green Building Initiative (http://www.greenglobes.com/design/homeca.asp).

4 ASU Campus Metabolism is an interactive web tool that displays real time energy use on campus (http://cm.asu.edu).