

**TENNESSEE BOARD OF REGENTS**

Appendix 2

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Tennessee Sustainable Design Guidelines

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## 1.01 Tennessee Sustainable Design

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### A. Introduction

The State of Tennessee Sustainable Design Guidelines (SDG) are to be used in conjunction with other state manuals and guidelines. Referenced standards within the SDG are intended to supplement or exceed the requirements of these other manuals and guidelines.

### B. Purpose and Intent

The Tennessee SDG is a project approved by the State Building Commission that is to be utilized by Real Property Administration (RPA), Tennessee Board of Regents (TBR), and the University of Tennessee (UT) as part of their Designer manuals as a minimum standard and guideline for Designers to insure that the principles of good sustainable design and construction practices are being implemented on State of Tennessee projects. The SDG has been created by the Tennessee Sustainability Task Force which is composed of representatives of The Office of the State Architect, University of Tennessee, Tennessee Board of Regents, Tennessee Higher Education Commission, and the consulting team of SSRcx, LLC and Hastings Architecture Associates, LLC. The purpose of the TN SDG is to provide Designer guidance and requirements for the design on all state building projects, under the jurisdiction of the State Building Commission, so that every project will be designed and constructed with a focus on preserving Tennessee's natural resources, and protecting the health and well-being of occupants and visitors to all state facilities. All measures being considered for credit compliance shall have an appropriate evaluation of costs (capital and operating) to and benefits (economic, environmental, and social) for the Owner. The SDG will be used as a design tool for all new construction, renovation, and maintenance projects. All new construction projects under the SDG will be designed and constructed with a focus on meeting or exceeding minimum standards established by recognized sustainable and energy efficient design organizations such as LEED<sup>®</sup>, Green Globes<sup>®</sup>, and Energy Star<sup>®</sup>. These guidelines have been formulated using the US Green Building Council's LEED<sup>®</sup> standards as a basis of comparison and are tailored specifically for State government use as they relate to projects developed by RPA, TBR, and UT.

### C. Procedure

The SDG shall be utilized on all project types, regardless of project size or scope, to identify applicable sustainable design opportunities.

1. Credit Responsibility – Design criteria of the SDG shall be applicable during all phases of a project including initiation, approval, design, and construction. The Owner, Designer, and Contractor shall be responsible for specific criteria as designated on the SDG checklist. The Designer shall submit an updated checklist to the Owner during each phase of the project.
  - a. Owner: The State of Tennessee, as Owner, shall be responsible for decisions on credits associated with site considerations, project scope, and building operations and maintenance.
  - b. Designer: The Designer shall be responsible for tracking the project's sustainable performance on the SDG Tracking Form, and reporting progress to the Owner's representative at each phase of the project. The Designer shall evaluate all credits of the SDG for feasibility of implementation in the project design. The Designer shall coordinate the implementation of assigned credits into the construction documents, record documentation from all responsible parties during construction, and report it to the Owner.

- c. Contractor: The Contractor shall be responsible for executing sustainable design criteria during construction, recording progress of assigned sustainable credits, and providing required sustainable construction documentation to the Designer.
2. Credit Level - Designers shall meet the **23** required credits and complete a minimum of **21** additional recommended and optional credits for a minimum of **44**, unless project types do not allow for compliance (such as small renovation projects that do not cover all areas of the SDG scope).
  - a. Required: Compliance with credit criteria is mandatory for all applicable projects.
  - b. Recommended: Compliance with credit criteria is recommended, where applicable, to project program; and when supported by project budget (first cost) and future operating budgets (operating costs).
  - c. Optional: Compliance with credit criteria is optional for Designers, and subsequent measures may be included upon investigation of feasibility (including first costs and operating costs) of sustainable benefits specific to the project.

#### **D. Organization**

The categories represent components of the project that should be considered for sustainability. These categories can be used by the Designer as a step-by-step guide for the project.

1. Land - The Designer should take into consideration the reuse of previously developed sites (brownfield development), erosion impacts during construction, the site's proximity to public transit systems, landscape design for native planting and reduced irrigation, reducing heat island effects, stormwater management, and exterior lighting pollution.
2. Water - The focus of this category is to decrease the demand for potable water. Strategies include less irrigation with native planting, stormwater reclamation and management, and low-flow interior fixtures.
3. Energy - Energy efficiency includes a type of commissioning, evaluation of building systems (pumps, fans, etc.) and instruments for their most efficient use, as well as onsite renewable energy possibilities (solar, wind, geothermal, etc.).
4. Materials - The Designer should consider opportunities to recycle all possible materials during construction and demolition processes such as cardboard, wood, plastics, and metals. The team should also consider rapidly renewable materials, materials with high recycled content, Forestry Stewardship Council (FSC) certified wood, and salvaged or other sustainable materials whenever possible.
5. Indoor environment - Indoor air quality should reflect a non-smoking building with ASHRAE and other standards met in ventilation and mechanical systems. The Designer should also stress Indoor Air Quality (IAQ) management during construction and a continued IAQ plan for occupancy.
6. Tennessee Innovation - This category includes innovative ideas and standards that move beyond the minimum requirements discussed in the previous categories.

#### **E. SDG Checklist and Calculators (Excel spreadsheet)**

1. Designers may obtain current versions of the Guidelines, Checklist, and Calculators from the State project manager or the following websites:
  - a. Real Property Management: Within the RPA's website, the Designer Manual can be found by going to the Office of State Architect page.
  - b. Tennessee Board of Regents: Within the TBR's website, the Designers' Manual can be found within the Office of Facilities Development's sub-page. The Tennessee Sustainable Design Guidelines are Appendix 2 of the Designers' Manual.
  - c. University of Tennessee: Within the UT website, perform a search for the Sustainable Design Guideline. This will lead to a link within the UT Facilities Services web page.
2. Checklist and Calculators include:
  - a. Checklist/Tracking Form
  - b. Project Close-Out and Credit Verification Form
  - c. Refrigerant Management Calculator
  - d. Materials and Resources Calculator
  - e. Daylight and Views Calculator

#### **F. Assessment Review**

1. The checklist and required documentation for all projects shall be submitted by the Designers and reported to the responsible agency for review.
2. While utilizing the SDG, Designers and state project managers should review all references and the latest addition of adopted codes, standards, regulations, etc. If any references are believed to be incorrect or out of date, this information should be communicated to the SDG Task Force for annual review.

## 1.02 Sustainable Design Guidelines

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### A. Land Management

1. Site. If the Designer is involved in site selection, document the following:
  - a. Re-use buildings and sites before building new. If the project is re-using an existing building, document the percentages of building components kept.
    - i. Percentage of existing walls, floor and roof kept.
    - ii. Percentage of interior non-structural elements kept.
  - b. If the Designer is involved in site selection, consider selecting land that does not have the following attributes:
    - i. Prime Farmland, per the USDA Code of Federal Regulations, or state or local guidelines.
    - ii. Previously undeveloped land within 5 vertical feet of a 100-year FEMA designated floodplain.
    - iii. Land that is habitat to endangered or threatened species on a Federal or State list.
    - iv. Land within 100 horizontal feet of a wetland, designated by Federal, State, or Local jurisdiction.
    - v. Previously undeveloped land within 50 horizontal feet of a water body that could support fish or recreation: rivers, lakes, and streams.
  - c. Remediate/restore and use contaminated/brownfield sites when possible. Brownfields are defined under an ASTM Phase II Environmental Assessment, EPA Brownfields definition, or other federal, state, or local assessments or cleanup programs.
  - d. Building orientation (maximize for solar use – described in 1.02.C.2.b)
  - e. Re-develop or develop sites in urban environments with existing infrastructure and pedestrian access to goods and services.
2. Site Disturbance During Construction
  - a. In order to effectively reduce erosion and sedimentation impacts, Best Management Practices (BMPs) must be designed, installed, and maintained during land disturbing activities for all projects. The Tennessee Erosion and Sediment Control Handbook provided by the Tennessee Department of Environment and Conservation (TDEC) is designed to provide information to planners, developers, engineers, and Contractors on the proper selection, installation, and maintenance of BMP's. The handbook is intended for use during the design and construction of all projects to protect waters of the State. It also aids in the development of Storm Water Pollution Prevention Plans (SWPPP's) and other reports, plans, or specifications required when participating in Tennessee's water quality regulations. The handbook is currently available at TDEC's website, under the Water Quality link to "Technical and Engineering Documents."  
[http://www.tennessee.gov/environment/wpc/sed\\_ero\\_controlhandbook/](http://www.tennessee.gov/environment/wpc/sed_ero_controlhandbook/)
  - b. On greenfield sites, limit all site disturbance to 40 horizontal feet beyond the building perimeter, 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.

### 3. Transportation

- a. Identify and/or plan for public mass transit near the building.
  - i. Two or more public or city funded bus lines within ¼ mile of the primary building entrance is ideal.
  - ii. Organize/map pedestrian routes from bus stops within ¼ mile and train stations within ½ mile of building entrance.
  - iii. Design/arrange a covered bus stop if the bus route cannot stop within 100 yards of the building entrance and the bus route is adjacent to the property boundary.
- b. Provide bicycle storage for 5% of building occupants (full-time equivalent employees) and showering/changing facilities for 0.5% of building occupants, within 200 yards of a building entrance.
- c. Provide preferred parking for carpool transit for 5% of all parking spaces or provide preferred parking for low emitting/fuel efficient vehicles for 5% of all parking spaces.

### 4. Landscape Design

- a. Vegetated Open Space:  
Design vegetated open space adjacent to the building equal to or greater in area than the building footprint.
- b. Plantings:
  - i. Utilize native and adapted vegetation that are climate-tolerant to Tennessee and applicable to sustainable design techniques. See definitions.
  - ii. [www.plantnative.org](http://www.plantnative.org) provides information regarding plant species native to Tennessee, including suppliers.

### 5. Design to reduce heat islands:

- a. Design 50% of site area as highly reflective or non-absorptive (excluding building footprint). Possible strategies are as follows:
  - i. Use pervious/open-grid paving materials to promote infiltration and reduce heat island effect.
  - ii. Utilize a parking deck to reduce the area of asphalt contributing to heat islands and to reduce the overall impervious area while contributing to runoff.
  - iii. Use light colored paving surfaces with a Solar Reflectance Index (SRI) greater than 29 to limit heat island effect. For reference, typical new white concrete has an SRI of 86; typical new grey concrete has an SRI of 36; and typical new asphalt has an SRI of 0.
  - iv. Plant tree types that will shade hardscape surfaces within 5 years to reduce urban heat islands.
- b. Roof Surfaces
  - i. For low-sloped roofs (slope  $\leq$  2:12), finished roof surface should have an SRI of 78 or greater for 75% of the roof surface.
  - ii. For steep-sloped roofs (slope  $>$  2:12), finished roof surface should have an SRI of 29 or greater for 75% of the roof surface.
  - iii. When utilizing vegetated roof surfaces, the vegetated space should cover 50% of the roof surface.
  - iv. When utilizing a combination of vegetated and high solar reflectance roof surfaces, install them such that the following equation is satisfied:  
$$(\text{Area of SRI Roof} / 0.75) + (\text{Area of Vegetated Roof} / 0.5) \geq \text{Total Roof Area.}$$



## 6. Stormwater Design Considerations

- a. On previously undeveloped (greenfield) sites, design the stormwater management system for post-development site discharge rate and volume to not exceed pre-development discharge rate and volume. Design and calculations should be based on a 2-year 24-hour storm, or local code guidelines, whichever is more stringent.
- b. On previously developed sites, design the stormwater management system for post-development site discharge rate and volume to be 25% less than pre-development discharge rate and volume. Design and calculations should be based on a 2-year 24-hour storm, or local code guidelines, whichever is more stringent.
- c. Design to remove 80% Total Suspended Solids from the first inch of rain for each rainfall event (90% of the average annual rainfall), or local code guidelines, whichever is more stringent. Recommended BMPs are as follows:
  - i. Bioswales and vegetated filter strips
  - ii. Retention ponds
  - iii. Vegetated roof
  - iv. Stormwater harvesting for re-use
  - v. Pervious paving materials
- d. Reference Tennessee Department of Environment and Conservation (TDEC) Storm Water Permitting Phase II MS4s:

<http://www.state.tn.us/environment/wpc/stormh2o/MS4II.shtml>

7. Exterior Site Lighting: Design building façade and site lighting with lighting power densities that promote safety but minimize light pollution from the building site.
  - a. Design exterior area lighting power densities not to exceed lighting power densities defined in ASHRAE 90.1-2007, Exterior Lighting Section.
  - b. Design the placement and fixture styles of site lighting to minimize luminance above the horizontal plane and to minimize light trespass at the site boundary.
  - c. Use fixture types designed as “cutoff” and “full-cutoff” styles to minimize fixture lumens emitted at 90 degrees or higher from straight down.
  - d. Select exterior fixtures and locate them on the site to minimize light trespass at the site boundary. Document the foot-candle levels at the site boundary with a site illumination model.

## B. Water Efficiency

### 1. Wastewater: Treatment and Conveyance

- a. On-site treatment of wastewater is to be considered on projects that do not have sewer access.
- b. Use of non-potable water for sewage conveyance or composting methods is to be determined on project by project basis. If utilized, collaborate closely with the local authority having jurisdiction regarding system design and implementation.

### 2. Reduced Potable Water Demand

- a. Exceed the Energy Policy Act of 2005 fixture flow and use rates by at least 20%, by installing high efficiency fixtures as specified below :

Commercial Fixtures	EPA Act Baseline	High Efficiency Fixtures
Commercial toilets	1.6 gallons per flush (gpf)	1.28 gpf <sup>1, 2</sup>
Commercial urinals	1.0 gpf	0.5 gpf <sup>3</sup>
Commercial restroom faucets	0.5 gallons per minute (gpm)	0.5 gpm
Showerheads	2.5 gpm	1.5 gpm
Kitchen faucets	2.2 gpm	1.8 gpm

<sup>1</sup> Tankless-type toilets that use dual-mode flushometers (1.6/1.1 gpf on the up/down flush) are an acceptable alternative.

<sup>2</sup> Tank-type toilets that use a dual-mode operation (1.6/0.9 gpf on the up/down flush) are an acceptable alternative.

<sup>3</sup> Ultra-High Efficiency urinals that use 0.13 gpf, or water-free urinals, are to be considered on a project-by-project basis.

- b. Use of auto-flow/auto-flush valves to be determined on a project-by-project basis.
- c. Irrigation: Design systems that use 50% less potable water than conventional means. Calculations are to be based on irrigation during the month of July. Minimize potable water use by incorporating as many water conservation measures listed below as feasible. When possible, also consider captured rainwater, recycled graywater, cooling tower blowdown, and/or municipally treated waste water for site landscape irrigation. Recommended water conservation measures include:
  - i. Plant selection and density
  - ii. Site placement of vegetation types
  - iii. Mulching of trees, shrubs, flower beds
  - iv. High efficiency technologies such as drip irrigation and micro-spray
  - v. Daily and yearly irrigation schedules
  - vi. Moisture and weather-based irrigation control

## C. Energy Efficiency and Atmosphere Protection

1. Commissioning: Commissioning shall occur on all State projects.
  - a. Early in design, discuss the project attributes regarding the size and complexity of the building systems to determine the necessary rigor of the commissioning process.
  - b. Basic commissioning: At a minimum, the Contractor shall demonstrate to an Owner's representative that the following systems and equipment are functioning per the design intent. Demonstration results shall be documented and provided to the Owner.
    - i. Heating, ventilating, air conditioning, and refrigeration systems and equipment.
    - ii. Lighting controls
    - iii. Domestic hot water
  - c. Enhanced commissioning: Enhanced commissioning scope is defined in other state documents.
2. Energy Efficiency of Building Systems
  - a. Project design shall comply with all mandatory and prescriptive requirements of ASHRAE/ANSI/IESNA Standard 90.1-2007, Energy Standard for Buildings except Low-Rise Residential Buildings, and approved addenda. A representative of the State can, at his/her discretion, recommend alternative compliance paths to any aspect of the prescriptive requirements of this ASHRAE/ANSI/IESNA standard in order to better accommodate the project scope.
  - b. Conceptual Energy Modeling
    - i. Designers shall provide energy modeling during conceptual phases of design utilizing the eQuest™ software. eQuest™ is downloadable for free from <http://doe2.com>.
    - ii. Project teams shall utilize eQuest™ for the following analyses in the SD and DD phases of design. eQuest™ templates (such as occupant schedules) should be used for building parameters that are not able to be specifically modeled in the conceptual phases of design:
      - a) Model the building geometry
      - b) Model the building energy consuming systems
      - c) Select the building orientation that best suits the site solar attributes (heat gain and daylighting) and topography.
      - d) Utilize utility rate structures projected to be employed for building operation.
      - e) Model projections for energy intensity (Btu/square foot) and annual utility cost (\$/year) for energy operation.
      - f) If warranted, the energy efficiency measures (EEM) wizard of eQuest™ can be used to make system comparisons for payback and energy savings for building components such as:
        - i) Building envelope (e.g. wall insulation, window insulating value)
        - ii) Building energy consuming systems (e.g. HVAC, lighting)
        - iii) Equipment and system controls (e.g. demand controlled ventilation)

- c. Designers may elect to provide a full-comparison energy model, in lieu of documenting compliance with all ASHRAE 90.1 prescriptive requirements. If pursued, the energy model shall be conducted in accordance with either Chapter 11 or Appendix G of the standard. A total of eight points are available in the SDG through the energy model, based on the total project energy saved as compared to the baseline. Whether the model is performed per Chapter 11 or Appendix G, the percent improvement / performance rating must be calculated according to section G1.2 of Appendix G in ASHRAE 90.1-2007. The point breakdown is as follows:

10%	1 credit
14%	2 credits
17.5%	3 credits
21%	4 credits
24.5%	5 credits
28%	6 credits
31.5%	7 credits
35% or above	8 credits

- d. The following aspects of standard 90.1-2007 are applicable to the State of Tennessee and summarized here for ease of use:
- i. The standard is organized as follows:
    - a) Purpose
    - b) Scope
    - c) Definitions
    - d) Administration and Enforcement
    - e) Building Envelope
    - f) Heating, Ventilating, and Air Conditioning
    - g) Service Water Heating
    - h) Power
    - i) Lighting
    - j) Other equipment (motors)
    - k) Energy Cost Budget Method (energy model)
    - l) Appendix G
  - ii. All counties in Tennessee are defined as climate zone 4A except counties of southwest Tennessee which are 3A: Chester, Crockett, Dyer, Fayette, Hardeman, Hardin, Haywood, Henderson, Lake, Lauderdale, Madison, McNairy, Shelby, and Tipton (per Table B-1).
  - iii. Applicable Building Envelope Requirements for Climate Zone 3A and 4A are contained in Table 5.5-3 and 5.5-4, respectively.
  - iv. Outdoor Air Economizers are not required (Table 6.5.1) but their use is encouraged for most system applications. Economizer controls shall comply with Tables 6.5.1.1.3A and B. Designers not utilizing economizers must document **either** that:
    - a) The economizer does not significantly contribute to energy savings over the life of the building (i.e., does not have a 10-year or less payback), **or**
    - b) That the applicable HVAC equipment meets the efficiency listed in Table 6.3.2.

- c) Motorized dampers for ductwork and equipment that communicates directly with the outdoors are required per section 6.4.3.3.2 with noted exceptions.
- d) Energy recovery may be required per section 6.5.6.
- e) Automatic lighting controls are required as described in section 9.4.1.1.
- f) HVAC system types shall be selected in accordance with section 11.3.2. Exceptions will be made where Designers can demonstrate that the proposed system type is more efficient than the standard.
- g) Consider the use of external shading (exterior overhangs) on windows facing east, south, or west.

### 3. Refrigerant Management

- a. Base building HVAC equipment containing 0.5 lb. or more of refrigerant shall comply with the following:
  - i. Do not use equipment that contains CFCs.
  - ii. Equipment that contains HCFCs or HFCs shall comply with either the following table (units are refrigerant pounds per ton of cooling: lb. /ton), or the spreadsheet calculator provided with this guideline. The following table assumes a default leakage rate of 2%, a default end of life refrigerant loss of 10%. If equipment manufacturers can prove otherwise, the use of the spreadsheet calculator is encouraged.

	10 Year Life	15 Year Life	20 Year Life	23 Year Life
Refrigerant	Room or Window AC & Heat Pumps	Unitary, split, & packaged AC & heat pumps	Reciprocating compressors & chillers	Centrifugal, screw, & absorption chillers
R-22	0.57	0.64	0.69	0.71
R-123	1.60	1.80	1.92	1.97
R-134a	2.52	2.80	3.03	3.10
R-245fa	3.26	3.60	3.92	4.02
R-407c	1.95	2.20	2.35	2.41
R-410a	1.76	1.98	2.11	2.17

- iii. Do not use Halons in fire suppression systems.

### 4. Instrumentation and Measurement

Design and install instrumentation that communicates with the building management controls system. Examples are provided in the following table:

Instrument	Unitary or Packaged A/C	Air handling units	AHUs with humidifiers	Chillers	Cooling towers	Boilers	Pumps
Supply air temperature	X	X	X				
Return air temperature	X	X	X				
Mixed air temperature		X	X				
Return air humidity			X				
Chilled water supply temperature				X			
Chilled water return temperature				X			
Condenser water supply temperature				X			
Condenser water return temperature				X			
Hot water supply temperature						X	
Hot water return temperature						X	
Status on/off				X	X		X

5. Onsite Renewable Energy

Evaluate project site for on-site renewable energy opportunities to offset the building’s energy consumption from local grid power. Possible on-site energy sources include:

- a. Solar photovoltaic
- b. Solar water heating
- c. Wind generated electricity
- d. Geothermal (geothermal is only considered “renewable” when heat from the ground is used to produce electricity)
- e. Low-impact (“micro”) hydroelectric systems

6. Green Power

Provide 35% of electrical power usage for a minimum of two years from grid source renewable energy technology (purchase renewable energy certificates), or provide 10% electrical power usage on an on-going basis through TVA’s Green Power Switch program.

**D. Material and Resource Use**

1. Recyclable Collection & Storage

- a. Coordinate all recycling efforts with the State organization that will occupy the building. Many State agencies have pre-existing recycling programs.
- b. Identify local / regional availability for collection of recyclables from the facility.
- c. Identify recyclable materials to be generated by building occupants and operations; including, but not limited to, the following:
  - i. Paper / cardboard
  - ii. Plastic
  - iii. Metal
  - iv. Glass
- d. Allocate space on-site for central collection and storage of recyclables. Size collection area to meet demand of building occupants. Below are guidelines for recycling areas. These figures can be used at the discretion of the project team:

<b>Building Square Footage</b>	<b>Minimum Recycling Area (sq. ft.)</b>
0 to 5,000	82
5,001 to 15,000	125
15,001 to 50,000	175
50,001 to 100,000	225
100,001 to 200,000	275
200,001 or greater	500

2. Construction Waste Management

- a. Identify availability of local construction waste hauling and recycling facilities within the region of the construction site.
  - i. One-stop facilities
  - ii. Specified material facilities (e.g. wood only, metal only)
- b. Identify recyclable waste materials anticipated during construction, including but not limited to the following:
  - i. Rubble: concrete, brick, block debris, etc.
  - ii. Wood
  - iii. Plastics
  - iv. Metals
  - v. Cardboard, packaging materials, etc.

- c. Contractor shall be required to develop a waste management plan, which includes the following:
    - i. Address procedures for sorting, hauling, and tracking rate of recyclables from construction site.
    - ii. Address training of onsite personnel to ensure participation in plan.
  - d. Design to maximize material standard modular dimensions and encourage reduced overage in construction material orders to minimize waste on site.
  - e. (Optional) Provide documentation during construction that 50% or more material has been diverted from the landfill to be salvaged or recycled.
3. Sustainable Material Preferences
- a. Select construction materials that are high in recycled content.
    - i. Research local availability of fly-ash concrete and synthetic gypsum board for use in construction when appropriate.
    - ii. Specify that submittals include percentages of recycled material by weight. Identify post-consumer and post-industrial recycled content.
    - iii. Contractor shall provide material verification with submittals.
  - b. Where practical, specify and utilize natural materials of rapidly renewable origins.
    - i. Rapidly renewable materials replenish in 10 years or less.
    - ii. Preferred renewable materials for use include linoleum, cotton batt insulation, wool carpet, cork and bamboo flooring.
    - iii. Contractor shall provide material verification with submittals.
  - c. Utilize Forest Stewardship Council (FSC) certified wood for 50% (based on cost) of wood building products used in the building.
    - i. Identify local and regionally available suppliers for FSC certified wood products near project site. Provide list of available FSC vendors to bidders.
    - ii. Specify FSC certified wood products for wood framing, flooring, sub flooring, doors and finishes.
    - iii. Specify requirements for FSC Chain of Custody (COC) documentation.
    - iv. Contractor shall provide material verification with submittals.
  - d. Where practical, utilize salvaged materials in design and construction of new facilities.
    - i. Identify locally available resources for salvaged materials that may meet the projects functional and aesthetic needs.
    - ii. Contractor shall provide material verification with submittals.



## **E. Indoor Environmental Quality**

1. Non-Smoking Facilities
  - a. All State owned and operated buildings are non-smoking.
  - b. Any designated smoking areas will be located as required by State law or at least 25 feet away from entries, outdoor air intakes or operable windows, whichever is more stringent.
2. Design to ASHRAE 62.1-2007 Ventilation for Acceptable Indoor Air Quality.
  - a. Utilize the ventilation rate procedure or IAQ procedure as described in the reference standard to reduce the introduction of airborne contaminants in mechanically distributed air.
3. For mechanical systems that utilize direct measurement of outdoor air:
  - a. Provide a measurement device with an accuracy of plus or minus 15% of the design minimum outdoor air rate.
  - b. Provide carbon dioxide monitors within all densely occupied spaces (greater than 25 people per 1000 sq. ft.) served by the air handling unit that measures outside air. Locate monitors between 3 and 6 feet above the floor. Monitors shall communicate with the building automation system to provide an alarm when carbon dioxide is out of range for the space.
4. During construction:
  - a. Meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2<sup>nd</sup> Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).
  - b. Protect stored on-site or installed absorptive materials from moisture damage.
  - c. If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grille. (The procedure for determining MERV ratings is contained in ASHRAE 52.2-1999.) Replace all filtration media immediately prior to occupancy.
5. Develop and implement an Indoor Air Quality (IAQ) Management Plan for the pre-occupancy phase as follows:
  - a. **OPTION 1 — Flush-Out**
    - i. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of between 80 and 60 degrees F and relative humidity no higher than 60%.
    - ii. If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500 cu. ft. of outdoor air per sq.ft. of floor area to the space. Once a space is occupied, it shall be ventilated per the design minimum outside air rate determined from ASHRAE 62.1-2007.
    - iii. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft. /sq. ft. of outside air has been delivered to the space.

- b. OPTION 2 — Air Testing
    - i. Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air.
6. All materials used in the construction of the building shall meet the following requirements:
- a. The Volatile Organic Compound (VOC) content of adhesives, sealants, and paints/coatings used shall not exceed the limits established below. Contractor shall provide material verification with submittals.
  - b. The VOC content of the following materials must be less than the limits indicated, unless materials are not available that do not also meet the functional needs of a given space.
    - i. Architectural Adhesives (g/L, less water):
 

a) Indoor Carpet:	50
b) Carpet Pad:	50
c) Wood Flooring:	100
d) Rubber Floor:	60
e) Subfloor:	50
f) Ceramic Tile:	65
g) VCT & Asphalt:	50
h) Drywall & Panel:	50
i) Cove Base:	50
j) Multipurpose:	70
k) Structural Glazing:	100
    - ii. Specialty Adhesives (g/L, less water):
 

a) PVC Welding:	510
b) CPVC Welding:	490
c) ABS Welding:	325
d) Plastic Cement:	250
e) Primer for Plastic:	550
f) Contact:	80
g) Special Purpose Contact:	250
h) Structural Wood Member:	140
i) Sheet Applied Rubber:	850
j) Top & Trim:	250
    - iii. Substrate Specific (g/L, less water):
 

a) Metal to Metal:	30
b) Plastic Foams:	50
c) Porous Material (except wood):	50
d) Wood:	30
e) Fiberglass:	80
    - iv. Sealants (g/L, less water):
 

a) Architectural:	250
b) Architectural Porous:	775
c) Non-membrane Roof:	300

- |  |                    |
|--|--------------------|
| d) Roadway:                            | 250                |
| e) Single-Ply Roof Membrane:           | 450                |
| f) Other:                              | 750                |
| g) Aerosol General Purpose mist spray: | 65% VOCs by weight |
| h) Aerosol General Purpose web spray:  | 55% VOCs by weight |
| i) Aerosol Special Purpose:            | 70% VOCs by weight |
- v. Paints (g/L less water):
- |               |    |
|---------------|----|
| a) Flats:     | 50 |
| b) Non-Flats: | 50 |
- vi. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates:
- |                  |     |
|------------------|-----|
| a) VOC limit is: | 250 |
|------------------|-----|
- vii. Coatings:
- |                                |     |
|--------------------------------|-----|
| a) Clear wood finish, varnish: | 350 |
| b) Clear wood finish, lacquer: | 550 |
| c) Floor coatings:             | 100 |
| d) Sealers and undercoaters:   | 200 |
| e) Shellac, clear:             | 730 |
| f) Shellac, pigmented:         | 550 |
| g) Stain:                      | 250 |
- c. Carpet systems must meet or exceed the requirements of the Carpet and Rug Institute's Green Label Plus Indoor Air Quality Test Program.
- i. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.
  - ii. All carpet adhesive: VOC limit of 50 g/L.
- d. Composite wood and agrifiber products must contain no added urea-formaldehyde resins.
7. Design to minimize and control pollutant entry into buildings and subsequent cross-contamination of regularly occupied areas:
- a. Employ permanent entryway systems at least six feet long in the primary direction of travel to capture dirt and particulates from entering the building at all entryways that are directly connected to the outdoors. Acceptable entryway systems include permanently installed grates, grilles, or slotted systems that allow for cleaning underneath. Roll-out mats are only acceptable when maintained on a weekly basis. Qualifying entryways are those that serve as regular entry points for building users.
  - b. Where hazardous gases or chemicals may be present or used, including garages, housekeeping/laundry areas, and designated copying/printing rooms, exhaust each space sufficiently to create negative pressure with respect to adjacent spaces with the doors to the room closed. For each of these spaces, provide self-closing doors and deck to deck partitions or a hard lid ceiling. The exhaust rate shall be at least 0.50 cfm/sq.ft. or per local codes, whichever is more stringent, with no air recirculation.
  - c. In mechanically ventilated buildings, provide regularly occupied areas of the building with air filtration media that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better when the mechanical system can accommodate such filtration. Filtration should be applied to process both return and outside air that is to be delivered as supply air. All filtration should be replaced immediately prior to occupancy.

8. Design HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy.
9. Occupant System Controls
  - a. Thermal Comfort
    - i. Provide individual comfort controls to 50% of building occupants.
    - ii. Provide operable windows to all occupants within 20 feet of exterior wall per ASHRAE 62.1-2007 paragraph 5.1, Natural Ventilation.
    - iii. Provide comfort system controls for all shared multi-occupant spaces per ASHRAE standard 55-2007.
  - b. Lighting Controls
    - i. Provide individual lighting controls for 90% of building occupants.
    - ii. Provide lighting system controllability for all shared multi-occupant spaces to allow lighting level adjustments that meet group needs.
10. Design the building envelope to achieve a 2% daylight factor in a minimum of 75% of all regularly occupied areas. The glazing factor is calculated as follows:
  - a.  $\text{Glazing Factor} = [(\text{Window Area} / \text{Floor Area}) \times \text{Window Geometry Factor} \times (\text{Actual Tvis} / \text{Minimum Tvis}) \times \text{Window Height Factor}]$
  - b. A spreadsheet calculator has been developed to calculate the Glazing factor from the information provided. This spreadsheet program includes all necessary instructions for calculating Glazing Factor from building geometry.
  - c. At the option of the Designer, a daylight simulation model may be used instead of or in addition to the above calculation method. Using a computer simulation model, demonstrate that a minimum daylight illumination level of 25 footcandles has been achieved in a minimum of 75% of all regularly occupied areas. Modeling must demonstrate 25 horizontal footcandles under clear sky conditions, at noon, on the equinox, at 30" above the finished floor.
11. Design the building envelope and space layout to allow a direct line of sight to the outdoor environment via vision glazing between 2'-6" and 7'-6" above finish floor for building occupants in 90% of all regularly occupied areas. Determine the area with direct line of sight by totaling the regularly occupied square footage that meets the following criteria:
  - a. In plan view, the area is within sight lines drawn from perimeter vision glazing.
  - b. In section view, a direct line of sight can be drawn from the area to perimeter vision glazing.
  - c. Line of sight may be drawn through interior glazing.
  - d. For private offices, the entire square footage of the office can be counted if 75% or more of the area has direct line of sight to perimeter vision glazing.
  - e. For multi-occupant spaces, the actual square footage with direct line of sight to perimeter vision glazing is counted.
  - f. The area square footage with direct line of sight divided by the total regularly occupied area square footage (converted to percent) is the Views percentage.
  - g. A spreadsheet calculator has been developed to calculate the Views percentage from the information provided. This spreadsheet program includes all necessary instructions for calculating Views percentage from building geometry.

## **F. Tennessee Advancement**

1. The Designer, Owner, and Contractor are encouraged to demonstrate greater accomplishments in sustainability by either exceeding the established standards of the above mentioned criteria, or by seeking innovative performance in sustainable categories not specifically addressed by these guidelines. The following are suggested topics that can be addressed with the goal of moving beyond the minimum requirements. For credit categories not listed, the Designer must submit a statement of intent for the proposed innovation, a measurable method of compliance, and a benchmark for acceptable performance to be reviewed by the State project manager. These will be reviewed annually by the SDG Taskforce for adoption into the SDG.
  - a. **Watershed Restoration:**

Tennessee waters support an astonishing variety of wildlife, including more than 325 species of fish, 132 species of mussels, and 101 species of crayfish. In addition, Tennessee's 70 amphibian, 61 reptile, 300 bird and 89 mammal species all rely on Tennessee's water resources. Four of the eight most ecologically rich rivers in North America are in Tennessee. Project teams are encouraged to assess nearby streams and watersheds regarding water quality and overall health of flora and fauna and engage in restoration practices in conjunction with TDEC guidelines.
  - b. **Green Housekeeping Practices:**
    - i. Select building materials that require minimal cleaning and maintenance.
    - ii. Provide information on proposed cleaning agents and the independent certification those agents adhere to. Document that the cleaning agents and building materials are compatible and that the building materials will maintain their integrity through their expected useful life.
  - c. **Exemplary Efforts in Recycled Content:**

Calculate 20% recycled content of construction materials.
  - d. **Exemplary efforts in Water Use Reduction:**

Calculate 40% reduction in potable water use.
  - e. **Construction Site Energy Efficiency:**

Meet at least two of the following requirements during construction:

    - i. Utilize alternative fuels such as bio-diesel in construction equipment.
    - ii. During construction, meet site lighting criteria of 1.02.A.7.a-d.
    - iii. During construction, coordinate evening site lighting with local curfew hours.
2. **Environmentally Accredited Project Team:**

Provide certification that a design or construction team member meets at least one of the following professional accreditations:

  - a. LEED AP (Accredited Professional)
  - b. Green Advantage Certification

### 1.03 Definitions

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**Acid Rain** - The precipitation of dilute mineral acids, formed by various industrial pollutants (primarily sulfur dioxide and nitrogen oxides) mixing with naturally occurring oxygen and water vapor.

**Adapted (Introduced) Plants** - Plants that grow well in a given habitat with minimal attention from humans in the form of winter protection, pest protection, water irrigation, or fertilization once root systems are established in the soil. Adapted plants are considered to be low maintenance but not invasive.

**Adaptive Reuse** - The renovation of a building or site to allow a particular use that was not originally intended.

**Adhesive** - Any substance that is used to bond one surface to another surface by attachment. Adhesives include adhesive bonding primers, adhesive primers, adhesive primers for plastics, and any other adhesive primer.

**Aerosol Adhesive** - An adhesive packaged as an aerosol product. Aerosol adhesives include special purpose spray adhesives, mist spray adhesives and web spray adhesives.

**Agrifiber Board** - A composite panel product derived from recovered agricultural waste fiber from sources including, but not limited to, cereal straw, sugarcane bagasse, sunflower husk, walnut shells, coconut husks, and agricultural prunings. The raw fibers are processed and mixed with resins to produce panel products with characteristics similar to those derived from wood fiber.

**Air Changes Per Hour (ACH)** - The number of times per hour a volume of air, equivalent to the volume of space, enters that space.

**Air Conditioning** - The process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness and distribution (ASHRAE 62.1-2004).

**Albedo** - Synonymous with solar reflectance.

**Alternative Fuel Vehicles** - Vehicles that use low-polluting, non-gasoline fuels such as electricity, hydrogen, propane, or compressed natural gas, liquid natural gas, methanol, and ethanol. Efficient gas-electric hybrid vehicles are included in this group for TSDG purposes.

**Angle of Maximum Candela** - The direction in which a fixture emits the highest lighting intensity.

**Anti-corrosive Paints** - Coatings formulated to prevent the corrosion of ferrous metal substrates.

**Aquatic Systems** - Ecologically designed treatment systems that utilize a diverse community of biological organisms (e.g., bacteria, plants and fish) to treat wastewater to advanced levels.

**Aquifer** - An underground water-bearing rock formation or group of formations which supplies groundwater, wells and springs.

**Assembly Recycled Content** - Includes the percentages of post-consumer and pre-consumer content. Determined by dividing the weight of recycled content by the weight of the entire assembly.

**Automatic Fixture Sensors** - Motion sensors that automatically turn on/off lavatories, sinks, water closets and urinals. Sensors may be hard wired or battery operated.

**Average Annual Building Users** - The average number of building occupants for an eight-hour schedule per workday. Average of measurements taken at the peak use period for the year, the low use period for the year, and the average use period for the year. An average is used because (for some building types) occupancy will fluctuate at different times of the year.

**Baseline Building Performance** - The annual energy cost for a building design intended for use as a baseline for rating above standard design, as defined in ASHRAE 90.1-2004 Informative Appendix G.

**Basis of Design (BOD)** - Includes design information necessary to accomplish the Owner's project requirements, including system descriptions, indoor environmental quality criteria, other pertinent design assumptions (such as weather data), and references to applicable codes, standards, regulations and guidelines.

**Biodiversity** - The variety of life in all forms, levels and combinations, including ecosystem diversity, species diversity, and genetic diversity.

**Biomass** - Plant material such as trees, grasses, and crops that can be converted to heat energy to produce electricity.

**Bioremediation** - Involves the use of microorganisms and vegetation to remove contaminants from water and soils. Bioremediation is generally a form of in-situ remediation, and can be a viable alternative to landfilling or incineration.

**Blackwater** - No nationally accepted definition. Wastewater from toilets and urinals is, however, always considered blackwater. Wastewater from kitchen sinks (perhaps differentiated by the use of a garbage disposal), showers, or bathtubs may be considered blackwater by state or local codes. Project teams should comply with the blackwater definition established by the local authorities.

**BMP** - Best Management Practices as defined by national, state or local codes or guidelines.

**Breathing Zone** - The region within an occupied space between 3 and 6 ft. above the floor and more than 2 ft. from the walls or fixed air-conditioning equipment.

**Brownfield** - Real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant or contaminant. See also [www.epa.gov/brownfields](http://www.epa.gov/brownfields)

**Building Density** - The floor area of the building divided by the total area of the site (square feet per acre).

**Building Envelope** - The exterior surface of a building's construction—the walls, windows, roof and floor. Also referred to as the "building shell."

**Building Footprint** - The area on a project site that is used by the building structure and is defined by the perimeter of the building plan. Parking lots, landscapes and other non-building facilities are not included in the building footprint.

**Carpool** - An arrangement in which two or more people share a vehicle for transportation.

**Car Sharing** - A system under which multiple households share a pool of automobiles, either through cooperative ownership or through some other mechanism.

**CERCLA** - Refers to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund. CERCLA addresses abandoned or historical waste sites and contamination. It was enacted in 1980 to create a tax on the chemical and petroleum industries and provided federal authority to respond to releases of hazardous substances.

**Chain-of-Custody** - A document that tracks the movement of a wood product from the forest to a vendor and is used to verify compliance with FSC guidelines. A "vendor" is defined as the company that supplies wood products to project contractors or subcontractors for on-site installation.

**Chlorofluorocarbons (CFCs)** - Hydrocarbons that deplete the stratospheric ozone layer.

**CO<sub>2</sub>** - Carbon dioxide

**Cogeneration** - The simultaneous production of electrical or mechanical energy (power) and useful thermal energy from the same fuel/energy source such as oil, coal, gas, biomass or solar.

**Comfort Criteria** - Specific original design conditions that shall at a minimum include temperature (air, radiant and surface), humidity, and air speed as well as outdoor temperature design conditions, outdoor humidity design conditions, clothing (seasonal) and activity expected(ASHRAE 55-2004).

**Commissioning (Cx)** - The process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in compliance with the Owner's project requirements.

**Commissioning Plan** - A document defining the commissioning process, developed in increasing detail as the project progresses through its various phases.

**Commissioning Report** - The document that records the results of the commissioning process, including the as-built performance of the systems, and unresolved issues.

**Commissioning Specification** - The contract document that details the objective, scope and implementation of the construction and acceptance phases of the commissioning process as developed in the design-phase commissioning plan.

**Commissioning Team** - Includes those people responsible for working together to carry out the commissioning process.

**Community** - An interacting population of individuals living in a specific area.

**Completed Design Area** - The total area of finished ceilings, finished floors, full height walls and demountable partitions, interior doors and built-in case goods in the space when the project is completed; exterior windows and exterior doors are not considered.

**Composite Wood** - A product consisting of wood or plant particles or fibers bonded together by a synthetic resin or binder (e.g., plywood, particle-board, OSB, MDF, composite door cores.)

**Composting Toilet Systems** - Dry plumbing fixtures that contain and treat human waste via microbiological processes.

**Conditioned Space** - The part of a building that is heated or cooled, or both, for the comfort of occupants (ASHRAE 62.1-2007).

**Construction and Demolition (C&D) Debris** - Includes waste and recyclables generated from construction, renovation, and demolition or deconstruction of pre-existing structures. Land clearing debris including soil, vegetation, rocks, etc. are not included.

**Construction IAQ Management Plan** - A document specific to a building project that outlines measures to minimize contamination in the building during construction, and procedures to flush the building of contaminants prior to occupancy.

**Contaminant** - An unwanted airborne constituent that may reduce air quality (ASHRAE 62.1-2007).

**Conventional Irrigation** - Refers to the most common irrigation system used in the region where the building is located. A common conventional irrigation system uses pressure to deliver water and distributes it through sprinkler heads above the ground.



**Curfew Hours** - Locally determined times when greater lighting restrictions are imposed. When no local or regional restrictions are in place, 10:00 p.m. is regarded as a default curfew time.

**Daylighting** - The controlled admission of natural light into a space through glazing with the intent of reducing or eliminating electric lighting. By utilizing solar light, daylighting creates a stimulating and productive environment for building occupants.

**Daylighting Zone** - The total floor area that meets the performance requirements for daylighting.

**Development Footprint** - The area on the project site that has been impacted by any development activity. Hardscape, access roads, parking lots, non-building facilities and building structure are all included in the development footprint.

**Direct Line of Sight to Perimeter Vision Glazing** - The area of regularly-occupied spaces with direct line of sight to perimeter vision glazing. The area determination includes full height partitions and other fixed construction prior to installation of furniture.

**Drip Irrigation** - A high-efficiency irrigation method in which water is delivered at low pressure through buried mains and sub-mains. From the sub-mains, water is distributed to the soil from a network of perforated tubes or emitters. Drip irrigation is a type of micro-irrigation.

**Ecosystem** - A basic unit of nature that includes a community of organisms and their non-living environment linked by biological, chemical and physical process.

**Embodied Energy** - Energy that is used during the entire life cycle of the commodity for manufacturing, transporting, and disposing of the commodity as well as the inherent energy captured within the product itself.

**Emissivity** - The ratio of the radiation emitted by a surface to the radiation emitted by a black body at the same temperature.

**Endangered Species** - An animal or plant species that is in danger of becoming extinct throughout all or a significant portion of its range due to harmful human activities or environmental factors.

**Energy Conservation Measures (ECMs)** - Installations of equipment or systems, or modifications of equipment or systems, for the purpose of reducing energy use and/or costs.

**ENERGY STAR® Rating** - The rating a building earns using the ENERGY STAR Portfolio Manager to compare building energy performance to similar buildings in similar climates. A score of 50 represents average building performance.

**Environmental Attributes of Green Power** - Include emission reduction benefits that result from green power being used instead of conventional power sources.

**Environmental Tobacco Smoke (ETS)** - Also known as secondhand smoke, consists of airborne particles emitted from the burning end of cigarettes, pipes, and cigars, and exhaled by smokers. These particles contain about 4,000 different compounds, up to 40 of which are known to cause cancer.

**Environmentally Preferable Products** - Products identified as having a lesser or reduced effect on health and the environment when compared with competing products that serve the same purpose.

**Environmentally Preferable Purchasing** - A United States federal-wide program (Executive Order 13101) that encourages and assists Executive agencies in the purchasing of Environmentally Preferable Products and services.

**Erosion** - A combination of processes in which materials of the earth's surface are loosened, dissolved, and transported from one place to another by natural agents (such as water, wind or gravity).

**Eutrophication** - The accumulation of nutrients that encourage dense algal growth, the decay of which depletes oxygen in shallow waters.

**Exfiltration** - Uncontrolled outward air leakage from conditioned spaces through unintentional openings in ceilings, floors and walls to unconditioned spaces or the outdoors caused by pressure differences across these openings due to wind, inside-outside temperature differences (stack effect), and imbalances between supply and exhaust airflow rates (ASHRAE 62.1-2007).

**Exhaust Air** - The air removed from a space and discharged to outside the building by means of mechanical or natural ventilation systems.

**Ex-situ Remediation** - Involves the removal of contaminated soil and groundwater. Treatment of the contaminated media occurs in another location, typically a treatment facility. A traditional method of ex-situ remediation is pump-and-treat technology that uses carbon filters and incineration. More advanced methods of ex-situ remediation include chemical treatment or biological reactors.

**Flat Coatings** - Coatings that register a gloss of less than 15 on an 85-degree meter or less than 5 on a 60-degree meter.

**Fly Ash** - The solid residue derived from incineration processes. Fly ash can be used as a substitute for portland cement in concrete.

**Footcandle (fc)** - A unit of illuminance equal to one lumen of light falling on a one-square foot area from a one candela light source at a distance of one foot.

**Formaldehyde** - A naturally occurring VOC found in small amounts in animals and plants, but is carcinogenic and an irritant to most people when present in high concentrations—causing headaches, dizziness, mental impairment, and other symptoms. When present in the air at levels above 0.1 ppm (parts per million), it can cause watery eyes, burning sensations in the eyes, nose, and throat; nausea; coughing; chest tightness; wheezing; skin rashes; and asthmatic and allergic reactions.

**Functional Performance Testing (FPT)** - The process of determining the ability of the commissioned systems to perform in accordance with the Owner's project requirements, basis of design, and construction documents.

**Full-Time Equivalent (FTE)** - A measure of building occupants that is equal to one person occupying a building for an eight-hour schedule per workday.

**Glazing Factor** - The ratio of interior illuminance at a given point on a given plane (usually the work plane) to the exterior illuminance under known overcast sky conditions. LEED uses a simplified approach for its credit compliance calculations. The variables used to determine the daylight factor include the floor area, window area, window geometry, visible transmittance ( $T_{vis}$ ) and window height.

**Graywater (also spelled greywater and gray water)** - Defined by the Uniform Plumbing Code (UPC) in its Appendix G, titled "Gray water Systems for Single-Family Dwellings," as "untreated household wastewater which has not come into contact with toilet waste. Gray water includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washer and laundry tubs. It shall not include wastewater from kitchen sinks or dishwashers." The International Plumbing Code (IPC) defines graywater in its Appendix C, titled "Graywater Recycling Systems," as "wastewater discharged from lavatories, bathtubs, showers, clothes washers, and laundry sinks." Some states and local authorities allow kitchen sink wastewater to be included in graywater. Other differences with the UPC and IPC definitions may be found in state and local codes. Project teams should comply with the graywater definitions as established by the local authority.

**Greenfield Sites** - Sites that have not been previously developed or graded and remain in a natural state.

**Green Advantage Certified Professional** - An Environmental Certification Program recognizing building practitioners who are knowledgeable in energy efficient and environmentally friendly building construction practices. Green Advantage Certified Professionals are recognized by the US Green Building Council for Innovation Credit in the LEED® rating system.

**Greenhouse Gases** - Gases such as carbon dioxide, methane and CFCs that are relatively transparent to the higher-energy sunlight, but trap lower-energy infrared radiation.

**Halons** - Substances used in fire suppression systems and fire extinguishers in buildings. These substances deplete the stratospheric ozone layer.

**Heat Island Effect** - Occurs when warmer temperatures are experienced in urban landscapes compared to adjacent rural areas as a result of solar energy retention on constructed surfaces. Principal surfaces that contribute to the heat island effect include streets, sidewalks, parking lots and buildings.

**Horizontal View at 42 Inches** - The approach used to confirm that the direct line of sight to perimeter vision glazing remains available from a seated position. It uses section drawings that include the installed furniture to make the determination.

**HVAC Systems** - Include heating, ventilating, and air-conditioning systems used to provide thermal comfort and ventilation for building interiors.

**Hybrid Vehicles** - Vehicles that use a gasoline engine to drive an electric generator and use the electric generator and/or storage batteries to power electric motors that drive the vehicle's wheels.

**Hydrochlorofluorocarbons (HCFCs)** - Refrigerants used in building equipment that deplete the stratospheric ozone layer, but to a lesser extent than CFCs.

**Hydrofluorocarbons (HFCs)** - Refrigerants that do not deplete the stratospheric ozone layer. However, some HFCs have high global warming potential and, thus, are not environmentally benign.

**Impervious Surfaces** - Surfaces that promote runoff of stormwater instead of infiltration into the subsurface. The imperviousness or degree of runoff potential can be estimated for different surface materials.

**Individual Occupant Spaces** - Typically private offices and open office plans with workstations.

**Indoor Adhesive, Sealant and/or Sealant Primer Product** - Defined as an adhesive or sealant product applied on-site, inside of the building's weatherproofing system.

**Indoor Air Quality** - The quality of air inside a space or building. Indoor air quality affects the health and well-being of building occupants.

**Indoor Carpet Systems** - Defined as carpet, carpet adhesive, or carpet cushion product installed on-site, inside of the building's weatherproofing system.

**Indoor Composite Wood or Agrifiber Product** - Defined as a composite wood or agrifiber product installed on-site, inside of the building's weatherproofing system.

**Indoor Paint or Coating Product** - Defined as a paint or coating product applied on-site, inside of the building's weatherproofing system.

**Infiltration** - Uncontrolled inward air leakage to conditioned spaces through unintentional openings in ceilings, floors and walls from unconditioned spaces or the outdoors caused by the same pressure differences that induce exfiltration (ASHRAE 62.1-2007).

**Infrared or Thermal Emittance** - A parameter between 0 and 1 (or 0% and 100%) that indicates the ability of a material to shed infrared radiation (heat). The wavelength range for this radiant energy is roughly 4 to 40 micrometers. Most building materials (including glass) are opaque in this part of the spectrum, and have an emittance of roughly 0.9. Materials such as clean, bare metals are the most important exceptions to the 0.9 rule. Thus clean, untarnished galvanized steel has low emittance, and aluminum roof coatings have intermediate emittance levels.

**In-situ Remediation** - Involves treatment of contaminants in place using technologies such as injection wells or reactive trenches. These methods utilize the natural hydraulic gradient of groundwater and usually require only minimal disturbance of the site.

**Installation Inspection** - The process of inspecting components of the commissioned systems to determine if they are installed properly and ready for systems performance testing.

**Interior Lighting Power Allowance** - The maximum light power in watts allowed for the interior of a building.

**Interior Non-structural Components Reuse** - Determined by dividing the area of retained components by the larger of the area of the prior condition or the area of the completed design.

**Invasive Plants** - Both indigenous and non-indigenous species or strains that are characteristically adaptable, aggressive, have a high reproductive capacity and tend to overrun the ecosystems in which they inhabit. Collectively they are one of the great threats to biodiversity and ecosystem stability.

**Laminate Adhesive** - An adhesive used in wood/agrifiber products (veneered panels, composite wood products contained in engineered lumber, door assemblies, etc.).

**Landfill** - A waste disposal site for the deposit of solid waste from human activities.

**Landscape Area** - Area of the site equal to the total site area less the building footprint, paved surfaces, water bodies, patios, etc.

**LEED Accredited Professional (AP)** - A design and construction industry professional who has been recognized by the US Green Building Council as an individual with expertise in the principles of green building design, construction, and operation.

**Life Cycle Analysis (LCA)** - An evaluation of the environmental effects of a product or activity holistically, by analyzing the entire life cycle of a particular material, process, product, technology, service or activity.

**Life Cycle Cost (LCC) Method** - A technique of economic evaluation that sums over a given study period the costs of initial investment (less resale value), replacements, operations (including energy use), and maintenance and repair of an investment decision (expressed in present or annual value terms).

**Life Cycle Inventory (LCI)** - An accounting of the energy and waste associated with the creation of a new product through use and disposal.

**Light Pollution** - Waste light from building sites that produces glare, is directed upward to the sky or is directed off the site.

**Lighting Power Density (LPD)** - The installed lighting power per unit area.

**Local Zoning Requirements** - Local government regulations imposed to promote orderly development of private lands and to prevent land use conflicts.

**Makeup Air** - Any combination of outdoor and transfer air intended to replace exhaust air and exfiltration (ASHRAE 62.1-2007).

**Mass Transit** - Includes transportation facilities designed to transport large groups of persons in a single vehicle such as buses or trains.

**Mass Transit Vehicles** - Vehicles typically capable of serving 10 or more occupants, such as buses, trolleys, light rail, etc.

**Mechanical Ventilation** - Ventilation provided by mechanical powered equipment, such as motor-driven fans and blowers, but not by devices such as wind-driven turbine ventilators and mechanically operated windows (ASHRAE 62.1-2007).

**Metering Controls** - Generally manual on/automatic off controls which are used to limit the flow time of water. These types of controls are most commonly installed on lavatory faucets and on showers.

**Micro-irrigation** - Involves irrigation systems with small sprinklers and micro-jets or drippers designed to apply small volumes of water. The sprinklers and micro-jets are installed within a few centimeters of the ground, while drippers are laid on or below grade.

**Mixed-mode Ventilation** - A ventilation strategy that combines natural ventilation with mechanical ventilation, allowing the building to be ventilated either mechanically or naturally; and at times both mechanically and naturally simultaneously.

**Native (Indigenous) Plants** - Plants that have adapted to a given area during a defined time period and that are not invasive. In America, the term often refers to plants growing in a region prior to the time of settlement by non-indigenous people.

**Natural Ventilation** - Ventilation provided by thermal, wind or diffusion effects through doors, windows or other intentional openings in the building (ASHRAE 62.1-2007).

**Net Metering** - A metering and billing arrangement that allows on-site generators to send excess electricity flows to the regional power grid. These electricity flows offset a portion of the electricity flows drawn from the grid. For more information on net metering in individual states, visit the DOE's Green Power Network website at [www.eere.energy.gov/greenpower/netmetering](http://www.eere.energy.gov/greenpower/netmetering)

**Non-flat Coatings** - Coatings that register a gloss of 5 or greater on a 60-degree meter and a gloss of 15 or greater on an 85-degree meter.

**Non-occupied Spaces** - Include all rooms used by maintenance personnel that are not open for use by occupants. Included in this category are janitorial, storage and equipment rooms, and closets.

**Non-porous Sealant** - A substance used as a sealant on non-porous materials. Non-porous materials do not have openings in which fluids may be absorbed or discharged. Such materials include, but are not limited to, plastic and metal.

**Non-potable Water** - Water that is not suitable for human consumption without treatment that meets or exceeds EPA drinking water standards.

**Non-regularly Occupied Spaces** - Includes corridors, hallways, lobbies, break rooms, copy rooms, storage rooms, kitchens, restrooms, stairwells, etc.

**Non-roof Impervious Surfaces** - Includes all surfaces on the site with a perviousness of less than 50%, not including the roof of the building. Examples of typically impervious surfaces include parking lots, roads, sidewalks and plazas.

**Non-water-using Urinal (also known as a dry urinal)** - A urinal that uses no water, but instead replaces the water flush with a specially designed trap that contains a layer of buoyant liquid that floats above the urine layer, blocking sewer gas and urine odors from the room.

**Off-gassing** - The emission of volatile organic compounds from synthetic and natural products.

**On-site Wastewater Treatment** - Uses localized treatment systems to transport, store, treat and dispose of wastewater volumes generated on the project site.

**Open Space Area** - Defined by local zoning requirements. If local zoning requirements do not clearly define open space, it is defined for the purposes of LEED calculations as the property area minus the development footprint; and it must be vegetated and pervious, with exceptions only as noted in the credit requirements section. For projects located in urban areas that earn SS Credit 2, open space also includes non-vehicular, pedestrian oriented hardscape spaces.

**Open-grid Pavement** - Defined for LEED purposes as pavement that is less than 50% impervious and contains vegetation in the open cells.

**Outdoor Air** - The ambient air that enters a building through a ventilation system, through intentional openings for natural ventilation, or by infiltration (ASHRAE 62.1-2007).

**Outdoor Lighting Zone Definitions** - Developed by IDA for the Model Lighting Ordinance, these definitions provide a general description of the site environment/context and basic site lighting criteria.

**Owner's Project Requirements (OPR)** - An explanation of the ideas, concepts and criteria that are determined by the Owner to be important to the success of the project (previously called the Design Intent).

**Paints** - Liquid, liquifiable or mastic compositions that are converted to a solid protective, decorative, or functional adherent film after application as a thin layer. These coatings are intended for on-site application to interior or exterior surfaces of residential, commercial, institutional or industrial buildings.

**Pedestrian Access** - Implies that pedestrians can walk to the services without being blocked by walls, freeways or other barriers.

**Percentage Improvement** - The percent energy cost savings for the Proposed Building Performance versus the Baseline Building Performance.

**Perviousness** - The percent of the surface area of a paving material that is open and allows moisture to pass through the material and soak into the earth below the paving system.

**Phenol Formaldehyde** – Synthetic polymer that off-gasses only at high temperature, and is used for exterior products; although many of those products are suitable for interior applications.

**Porous Sealant** - A substance used as a sealant on porous materials (e.g. wood, fabric, paper, corrugated paperboard, plastic foam). Porous materials have tiny openings, often microscopic, in which fluids may be absorbed or discharged.

**Post-consumer** - Waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. This includes returns of materials from the distribution chain (source: ISO 14021). Examples of this category include construction and demolition debris, materials collected through curbside and drop-off recycling programs, broken pallets (if from a pallet refurbishing company, not a pallet making company), discarded products (e.g., furniture, cabinetry and decking) and urban maintenance waste (e.g., leaves, grass clippings, tree trimmings).

**Potable Water** - Water suitable for drinking and supplied from wells or municipal water systems.

**Ppb** - Parts per billion

**Ppm** - Parts per million

**Pre-consumer Content** - Defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it (source ISO 14021). Examples in this category include planer shavings, plytrim, sawdust, chips, bagasse, sunflower seed hulls, walnut shells, culls, trimmed materials, print overruns, over-issue publications, and obsolete inventories. (Previously referred to as Post-industrial Content.)

**Preferred Parking** - Refers to parking spots that are closest to the main entrance of the project, exclusive of spaces designated for handicapped.

**Previously Developed Sites** - Sites that previously contained buildings, roadways, parking lots, or were graded or altered by direct human activities.

**Primer** - A material applied to a substrate to improve adhesion of a subsequently applied coating.

**Prior Condition Area** - The total area of finished ceilings, finished floors, full height walls and demountable partitions, interior doors and built-in case goods that existed when the project area was selected; exterior windows and exterior doors are not considered.

**Process Water** - Water used for industrial processes and building systems such as cooling towers, boilers and chillers.

**Project Boundary** - The portion of the project site to be evaluated as a part of the SDG. For single building developments, this will be the entire project scope and is generally limited to the site boundary. For multiple building developments, the project boundary may be a portion of the development as determined by the project team.

**Property Area** - The total area within the legal property boundaries of a site and encompassing all areas of the site, including constructed areas and non-constructed areas.

**Proposed Building Performance** - The annual energy cost calculated for a proposed design, as defined in ASHRAE 90.1- 2007 Informative Appendix G.

**Public Transportation** - Bus, rail or other transportation service for the general public, operating on a regular, continual basis that is publicly or privately owned.

**Rapidly Renewable Materials** - Material considered to be an agricultural product, either fiber or animal, that takes 10 years or less to grow or raise, and that can be harvested in an ongoing and sustainable fashion.

**Rated Power** - The nameplate power on a piece of equipment. It represents the capacity of the unit and is the maximum a unit will draw.

**RCRA** - The Resource Conservation and Recovery Act. RCRA focuses on active and future facilities. It was enacted in 1976 to give the EPA authority to control hazardous wastes from cradle to grave, including generation, transportation, treatment, storage and disposal. Some non-hazardous wastes are also covered under RCRA.

**Receptacle Load** - Refers to all equipment that is plugged into the electrical system, from office equipment to refrigerators.

**Recirculated Air** - The air removed from a space and reused as supply air (ASHRAE 62.1-2007).

**Recycling** - The collection, reprocessing, marketing and use of materials that were diverted or recovered from the solid waste stream.

**Refrigerants** - The working fluids of refrigeration cycles. Refrigerants absorb heat from a reservoir at low temperatures and reject heat at higher temperatures.

**Regionally Extracted Materials** - For TSDG purposes, must have their source as a raw material from within a 500 mile radius of the project site.

**Regionally Manufactured Materials** - For TSDG purposes, must be assembled as a finished product within a 500 mile radius of the project site. Assembly, as used for this TSDG definition, does not include on-site assembly, erection or installation of finished components, e.g., structural steel, miscellaneous iron or systems furniture.

**Regularly Occupied Spaces** - Areas where workers are seated or standing as they work inside a building; in residential applications it refers to living and family rooms.

**Relative Humidity** - The ratio of partial density of water vapor in the air to the saturation density of water vapor at the same temperature and the same total pressure (ASHRAE 55-2004).

**Remediation** - The process of cleaning up a contaminated site by physical, chemical or biological means. Remediation processes are typically applied to contaminated soil and groundwater.

**Renewable Energy Certificates (RECs)** - RECs are a representation of the environmental attributes of green power, and are sold separately from the electrons that make up the electricity. RECs allow the purchase of green power even when the electrons are not purchased.

**Retained Components** - The portions of the finished ceilings, finished floors, full height walls and demountable partitions, interior doors and built-in case goods that existed in the prior condition and remained in the completed design.

**Return Air** - The air removed from a space to then be recirculated or exhausted (ASHRAE 62.1-2007).

**Reuse** - A strategy to return materials to active use in the same or a related capacity.

**Risk Assessment** - A methodology used to analyze for potential health effects caused by contaminants in the environment. Information from the risk assessment is used to determine cleanup levels.

**Salvaged Materials** - Construction materials recovered from existing buildings or construction sites and reused in other buildings. Common salvaged materials include structural beams and posts, flooring, doors, cabinetry, brick and decorative items.

**Sealant** - Any material with adhesive properties that is formulated primarily to fill, seal, or waterproof gaps or joints between two surfaces. Sealants include sealant primers and caulks.

**Secure Bicycle Storage** - An internal or external space dedicated to the secure storage of bicycles. This should be available to all building users and may include lockers and storage rooms.



**Sedimentation** - The addition of soils to water bodies by natural and human-related activities. Sedimentation decreases water quality and accelerates the aging process of lakes, rivers and streams.

**Shared (Group) Multi-occupant Spaces** - Includes retail sales floors, conference rooms, classrooms and other indoor spaces used as a place of congregation for presentations, trainings, etc. Individuals using these spaces share the lighting and temperature controls and they should have, at a minimum, a separate zone with accessible thermostat and an air-flow control.

**Site Area** - Synonymous with property area.

**Site Assessment** - An evaluation of above-ground (including facilities) and subsurface characteristics, including the geology and hydrology of the site, to determine if a release has occurred, as well as the extent and concentration of the release. Information generated during a site assessment is used to support remedial action decisions.

**Solar Reflectance (Albedo)** - The ratio of the reflected solar energy to the incoming solar energy over wavelengths of approximately 0.3 to 2.5 micrometers. A reflectance of 100% means that all of the energy striking a reflecting surface is reflected back into the atmosphere and none of the energy is absorbed by the surface. The best standard technique for its determination uses spectro-photometric measurements with an integrating sphere to determine the reflectance at each different wavelength. An averaging process using a standard solar spectrum then determines the average reflectance (see ASTM Standard E903).

**Solar Reflectance Index (SRI)** - A measure of a material's ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. For example, a standard black surface has a temperature rise of 90°F (50°C) in full sun, and a standard white surface has a temperature rise of 14.6°F (8.1°C). Once the maximum temperature rise of a given material has been computed, the SRI can be computed by interpolating between the values for white and black. Materials with the highest SRI values are the coolest choices for paving. Due to the way SRI is defined, particularly hot materials can even take slightly negative values, and particularly cool materials can even exceed 100. (Lawrence Berkeley National Laboratory Cool Roofing Materials Database)

**Square Footage** - The total area in square feet of all rooms of a building, including corridors, elevators, stairwells and shaft spaces.

**Stormwater Runoff** - Water volumes that are created during precipitation events and that flow over surfaces into sewer systems or receiving waters. All precipitation waters that leave project site boundaries on the surface are considered to be stormwater runoff volumes.

**Supply Air** - The air delivered by mechanical or natural ventilation to a space, composed of any combination of outdoor air, recirculated air, or transfer air (ASHRAE 62.1-2007).

**Sustainable Forestry** - The practice of managing forest resources to meet the long-term forest product needs of humans while maintaining the biodiversity of forested landscapes. The primary goal is to restore, enhance and sustain a full range of forest values—economic, social and ecological.

**System Performance Testing** - The process of determining the ability of the commissioned systems to perform in accordance with the Owner's Project Requirements, Basis of Design, and construction documents.

**Tenant Sales or Lease Agreement** - The contractual agreement for a tenant lease arrangement, or a buyer's sales arrangement.

**Tertiary Treatment** - The terminal form of wastewater treatment that includes the removal of nutrients, organic and solid material, along with biological or chemical polishing (generally to effluent limits of 10 mg/L BOD5 and 10 mg/L TSS).

**Thermal Comfort** - A state of mind experienced by building occupants expressing satisfaction with the thermal environment.

**Threatened Species** - An animal or plant species that is likely to become endangered within the foreseeable future.

**Tipping Fees** - Fees charged by a landfill for disposal of waste by weight. The fee is typically quoted for one ton of waste.

**Total Suspended Solids (TSS)** - Particles or flecks that are too small or light to be removed from stormwater by gravity settling. Suspended solid concentrations are typically removed by filtration.

**Visible Light Transmittance (Tvis)** - The ratio of total transmitted light to total incident light. It is the amount of visible spectrum light (380 – 780 nanometers) passing through a glazing surface, divided by the amount of light striking the glazing surface. Tvis is typically represented as a number between 0 and 1. A higher Tvis value indicates that a greater amount of visible spectrum incident light is passing through the glazing.

**Underground Parking** - A “tuck-under” or stacked parking structure that reduces the exposed parking surface area.

**Urea Formaldehyde** - A combination of urea and formaldehyde that is used in some glues and may emit formaldehyde at room temperature.

**Ventilation** - The process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity, or temperature within the space (ASHRAE 62.1-2007).

**Verification** - The full range of checks and tests carried out to determine if all components, subsystems, systems, and interfaces between systems operate in accordance with the contract documents. In this context, “operate” includes all modes and sequences of control operation, interlocks and conditional control responses, as well as specified responses to abnormal or emergency conditions.

**Vision Glazing** - The portion of exterior windows above 2’-6 and below 7’-6 that permits a view from an interior space to the outside of the project space.

**VOCs (Volatile Organic Compounds)** - Carbon compounds that participate in atmospheric photochemical reactions (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonates, and ammonium carbonate). These compounds vaporize at normal room temperatures.

**Wetland Vegetation** - Plants that require saturated soils to survive as well as certain tree and other plant species that can tolerate prolonged wet soil conditions.

**Window to Floor Area Ratio (WFR)** - This is the total area of the window (measured vertically from 2’-6” or greater above finish floor, to the top of the glass, multiplied by the width of the glass) divided by the floor area.